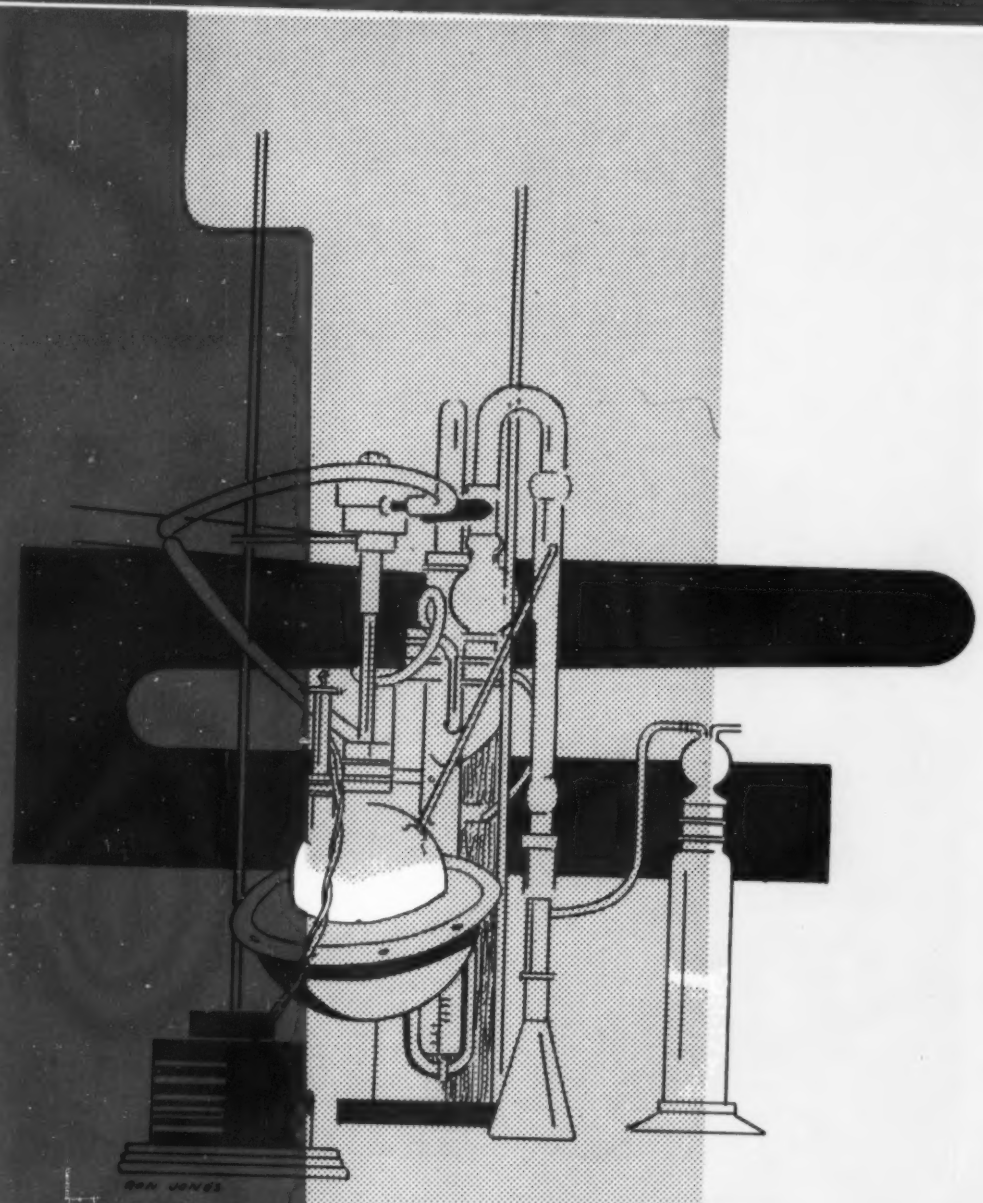
JUNE • 1954

NLGI Spokesman

Journal of National Lubricating Grease Institute



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President's page

by G. A. OLSEN, President, N L G I

THE PRICE OF LEADERSHIP

The assumption of leadership of the free world by our nation carries with it the requirement of fashioning a forthright policy of maintaining and expanding personal freedom throughout the world with a continuing faith in the promulgation of that policy. Each individual citizen must necessarily share in the cost of protecting and ever widening our influence in a free world, which will not only call for spiritual faith, but also materials, financial aid, and manpower—both technological and military.

Likewise, those segments of industry which, through driving force of management or size of operation create a position of industry leadership, must of necessity assume the responsibilities which such leadership has incurred and be ever ready to publicly justify their actions.

Individually, we should not evade the opportunity of leadership, even though it may carry with it a price tag requiring sacrifice of time, energy, and monetary gain, keeping in mind that we will be contributing to the further development of industry, country, and the free world.

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ABOUT THE COVER

This month we showed our artist the picture you see on page 9 illustrating the article Oxidized Petroleum Wax as a Grease Base. Evidently he dotes on illustrations that are so complex he can't figure them out. He had a real field day drawing up the intricate equipment you see on the cover.

Authors Kirk and Nelson tell us it's the laboratory apparatus they used for the study of reaction variables in wax oxidation.

Oxidized Petroleum Wax As a Grease Base

J. C. Kirk
E. W. Nelson

Continental Oil Company

Introduction

While the trends in the field of lubrication are gradually changing, with increasing emphasis being placed on specialized lubricants which will provide adequate protection under very severe and extreme operating conditions, there is little doubt but that the soap-thickened type of greases will continue to supply the greater proportion af all requirements for a very long time to come. In most cases where equipment is properly designed and maintained, and operating conditions are not too extreme, good quality soap-thickened greases of proper consistencies will provide adequate and completely satisfactory service at minimum cost.

To obtain good quality products requires, of course, good quality basic raw materials properly compounded. The saponifiable base necessary for a soap thickened grease should be of a uniform nonvarying composition with preferentially a minimum of price fluctuations. While this condition may seem to have been reached at the present time, all we need do is take a look at the record of raw material prices and qualities over the past few years to realize how great this fluctuation can be. With changing political ideologies and world economics, who knows how soon a similar situation might again develop?

The latter condition has perhaps been the major incentive for much of the investigation and research which has been carried on in the development of a saponifiable base from a practically limitless and nonfluctuating source which may be satisfactorily used for the preparation of soap-thickened lubricating greases. Such a raw material source may be obtained by oxidation of the paraffinic wax obtained in the normal refining of petroleum hydrocarbon oils.

Work on this subject has been carried on over a long period of years by numerous investigators with varying degrees of success, and some commercial applications have followed. In general, the volume of such materials which have been used has been insignificant primarily for the reason that oxidation processes which have previously been used do not provide a saponifiable base of suitable characteristics for the preparation of lubricating greases.

While the first part of this investigation was concerned primarily with the development of a suitable oxidation process, the over-all objective was the development of a saponifiable base which could be used for grease manufacture. Since the success of the oxidation process was evaluated in terms of the quality of the grease produced, both phases were carried out concurrently.

This investigation was concerned primarily with using the oxidized wax in its crude form with only a minimum amount of refining or beneficiating. It was early recognized that any degree of processing or refining which would provide a base of drastically revised composition would also increase its cost to the extent that it would be uneconomic; hence the problem became one of developing an oxidation process whereby the resulting base could be used as such and would have a greater proportion of desirable components and less of the undesirable. It is well known that oxidation of a material of this type

gives rise to a vast number of compounds of varying degrees of reactivity and stability. The type and proportion of the various components can be varied to some extent, depending upon the manner of oxidation.

Experimental

1. Wax Oxidation

A number of excellent reviews of hydrocarbon oxidation have been published [1, 2, 3]. The most effective catalysts are the transition metals, their oxides, and their salts. Usually, oil-soluble salts such as naphthenates or stearates are employed. A mixture of very finely divided manganese dioxide and zinc stearate has been found to be a particularly effective catalyst.

Description of Waxes Used

The wax used in this work was obtained from 400 Pale Oil operations, and contained 20-25% oil. In spite of this high oil content, this wax oxidized at the same rate and gave the same proportion of hydroxy acids as scale wax (m.p. 128-132° F.) containing 2% oil. Bright Stock Petrolatum was much more difficult to oxidize, and gave more hydroxy-acids than the above waxes.

Preparation of Manganese Dioxide

It was demonstrated that the activity of manganese dioxide depends on its particle size or surface area. Manganese dioxide having a uniform, very small particle size of approximately 0.3 micron, was prepared by a modification of the method of Joshi and Narayan for the preparation of colloidal manganese dioxide [4]. Concentrated ammonium hydroxide was added dropwise with stirring to a boiling solution of potassium permanganate until the purple color disappeared. The brown precipitate was removed by filtration, washed wtih distilled water, and dried over night at 110° C.

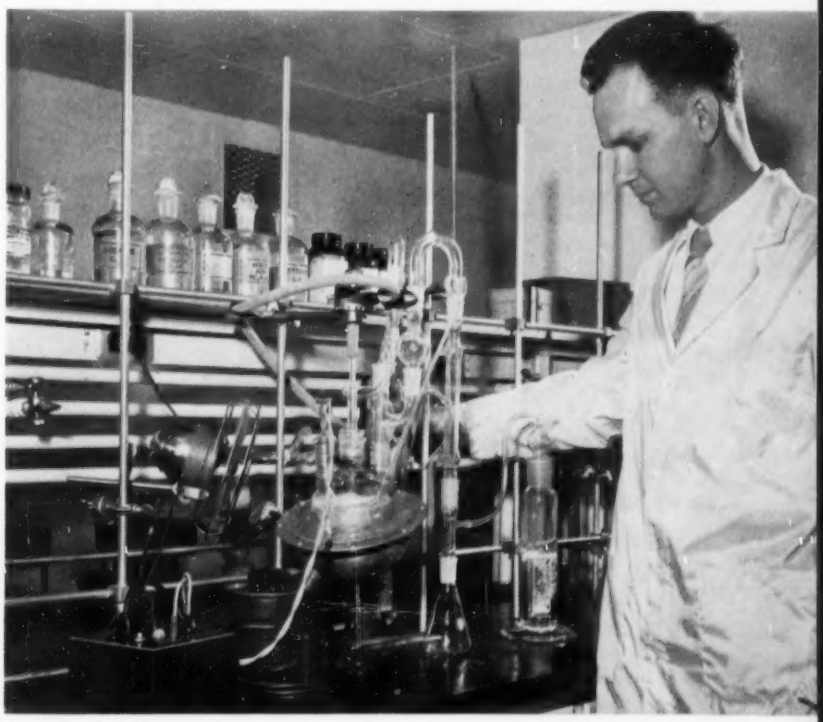
A Typical Oxidation

The reaction vessel was a 1-liter, 3-necked flask with two large indentations in the sides to provide turbulence. The flask was fitted with a thermometer, reflux condenser, stirrer, fritted glass air inlet, and thermostat. The thermostat was connected through a two-way relay to a heating mantle under the flask and a cooling fan directed at the top of the flask. This arrangement for alternate heating and cooling was necessary for precise temperature control. Four hundred grams of wax from 400 Pale Oil operations were placed in the flask and heated to 135°C. A mixture of 3.7 g. of zinc stearate and 0.3 g. of "colloidal" manganese dioxide was added. The stirrer was adjusted to approximately 800 r.p.m. and the air rate was set at 6.4 liters per minute.

After 4½ hours oxidation at 135°C., catalyst was removed by filtration; and the product was washed twice with hot water to give a yield of 100 weight per cent of light colored product having an acid number of 55.6. Oxidation for a total of nine hours gave a product having an acid number of 98. Analyses of these products are given in Table I. Large batches were oxidized in a stainless steel kettle by the same general method.

Table I
ANALYSIS OF TYPICAL OXIDIZED WAXES

Acid Number	55.6	98.0
Saponification Number	113	210
Per Cent Unsaponifiables	47	26.5
Per Cent Fatty Acids (after saponification)	41	62.8
Acid Number of Fatty Acids	150	164
Per Cent OH of Fatty Acids	1.72	2.47
Per Cent OH of Unsaponifiables	1.14	1.26
Bromine Number		0.8
Per Cent Unreacted Wax		8.2



Shown here is laboratory apparatus for the study of reaction variables in wax oxidation.

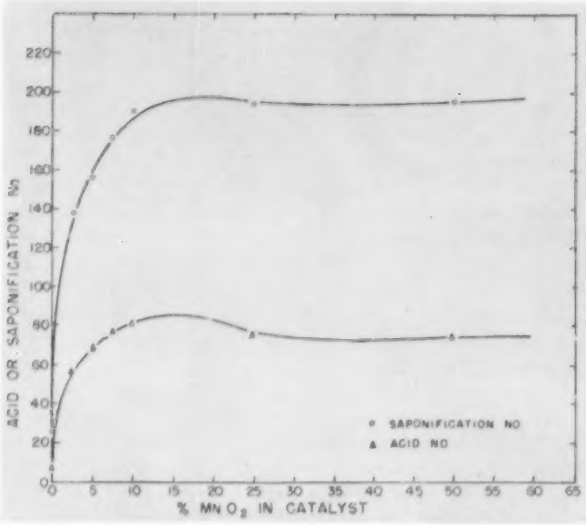


Figure 1—Effect of catalyst composition on rate of oxidation.

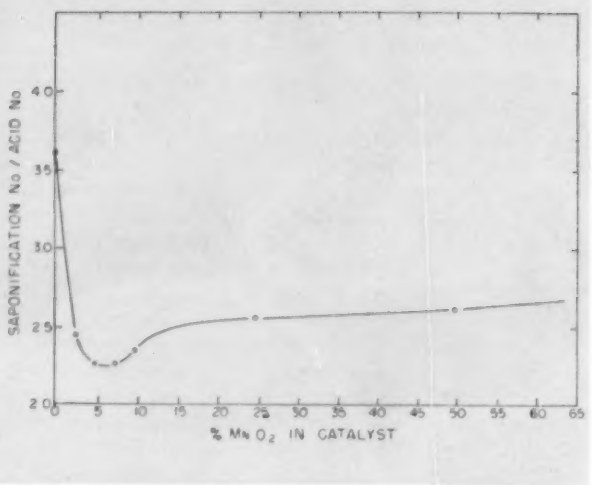


Figure 2—Effect of catalyst composition on hydroxy-acid formation.

Catalyst Composition Studies

Figure I illustrates the effect of increasing the proportion of manganese dioxide in the catalyst mixture with zinc stearate. In all cases, the total amount of catalyst was one per cent of the initial material, the air rate was 6.4 L./min., the temperature was 135°C., and the reaction time was seven hours. Above 15% manganese dioxide in the catalyst, the rate of oxidation is independent of the amount of manganese dioxide present. One possible explanation is that free radical chains are both initiated and terminated on the surface of the solid manganese dioxide so that "the constant maximum velocity represents the condition where surface initiation and termination terms dominate the rate equation and the concentration of the surface then cancels out [5].

The ratio of the saponification number to the acid number is believed to be a fairly reliable index of the degree of hydroxy-acid formation. When this ratio is plotted against the manganese dioxide content of the catalyst as shown in Figure II, a minimum in hydroxy-acid formation is found to occur at approximately 7.5 per cent manganese dioxide. This optimum mixture was used in subsequent oxidations.

Various alkaline materials such as sodium carbonate [6] and sodium stearate [7] have been reported to increase the rate of oxidation and promote the formation of unsubstituted fatty acids. Figure III shows that with a mixture of manganese dioxide and zinc stearate, small amounts of sodium stearate accelerate oxidation. However, this increase is due to formation of esters since the acid number remains constant. Large amounts of sodium stearate inhibit oxidation.

Optimum Air Rate

Early in this study, an air rate of 6.4 L./min. was arbitrarily chosen for oxidations in the one-liter flasks previously described. Determination of the optimum air rate for this apparatus revealed that this choice was very fortunate. At approximately this air rate, the rate of oxidation is at a maximum. When one plots the saponification number and the acid number against air rate and doubles the acid number scale as in Figure IV, one finds that the two curves coincide quite closely over the whole range of air rates. A plot of the ratio of the saponification number to the acid number against air rate in Figure V reveals that this ratio approaches 2 as a minimum value at approximately the same air rate which produces the most rapid oxidation. It should be mentioned that the optimum air rate would be different for each apparatus and is determined by the intimacy and length of contact of the air with the wax.

Oxidation of Bright Stock Petrolatum

Bright Stock Petrolatum is more difficult to oxidize than scale wax or wax from 400 Pale Oil. A reaction temperature of 175°C. was necessary to obtain a reasonable rate of oxidation. Figure VI shows the effect of temperature on the formation of hydroxy acids. The ester number (saponification number minus acid number) of the product increases steadily with increased reaction temperature. This increase in formation of esters with an increase in reaction temperature is perhaps related to an increase in the rate of thermal decomposition of hydroperoxides leading to formation of hydroxy compounds, which in turn esterify part of the free acids. After a steady state is achieved, the acid number and saponification number curves (Figure VII) are parallel, indicating simultaneous formation of acids and esters.

Mechanism of Paraffin Oxidation

1. Formation of Hydroperoxides

Formation of alkyl hydroperoxides is now generally accepted as the first phase of hydrocarbon oxidation. George[5] has shown by addition of inert powders to the reaction mixture that the surface initiates oxidation chains by primary absorption of oxygen followed by a rapid reaction with hydrocarbon to yield chain carriers. For low surface areas, the rate is proportional to the surface;

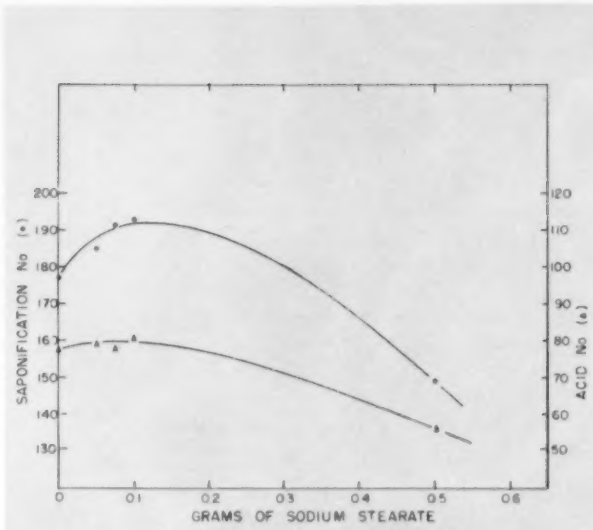


Figure 3—Effect of sodium stearate.

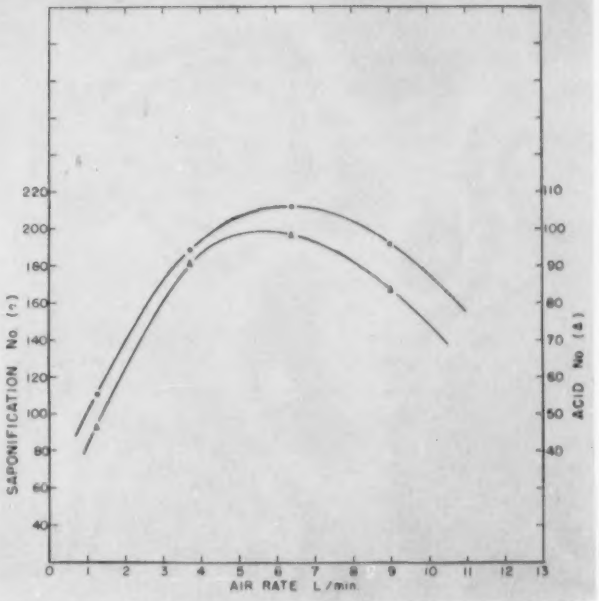


Figure 4—Effect of air rate.

but with increasing amounts of added solid a constant maximum rate is reached.

George ascribes this phenomenon to the fact that the chains are both initiated and terminated on the surface.

$$S + O_2 \rightarrow S{-}O_2$$
$$S{-}O_2 + RH \rightarrow R^{\bullet} + {}^{\bullet}O_2H$$
$$R^{\bullet} + O_2 \rightarrow RO_2^{\bullet}$$
$$RO_2^{\bullet} + RH \rightarrow RO_2H + R^{\bullet}$$

2. Hydroperoxide Decomposition

In the presence of acids, cumene hydroperoxide rearranged to give phenol and acetone exclusively, while rearrangement catalyzed by ferrous ions leads to acetophenone and methanol[8].

$$C_6H_5\text{-}C(CH_3)_2\text{-}OOH \xrightarrow{H^+} [C_6H_5\text{-}O\text{-}C(CH_3)_2] \rightarrow C_6H_5OH + CH_3COCH_3$$

One would predict that formaldehyde would be produced by rearrangement of a primary hydroperoxide. The odor of formaldehyde is very pronounced in the early stages of oxidation. Secondary hydroperoxides should yield higher aldehydes and tertiary hydroperoxides should produce ketones.

(a) $R\text{-}CH_2\text{-}OOH \rightarrow [R\text{-}O\text{-}CH_2] \rightarrow R\text{-}OH + HCHO$

(b) $R\text{-}CH_2\text{-}CH(OOH)\text{-}R' \rightarrow [R\text{-}CH_2\text{-}O\text{-}CH(OH)\text{-}R'] \rightarrow R\text{-}CH_2OH + R'CHO$

(c) $R\text{-}C(OOH)(R'')\text{-}R' \rightarrow [R\text{-}O\text{-}C(R'')(R')] \rightarrow ROH + R''\text{-}CO\text{-}R'$

3. Further Oxidation of Cleavage Fragments

(a) $R\text{-}CHO + O_2 \rightarrow R\text{-}CO_2H$

$$R\text{-}CO_2H + R'CH_2OH \rightarrow R\text{-}CO_2H + R'\text{-}CHO + H_2O$$

(b) $R'\text{-}CHO + O_2 \rightarrow R'\text{-}CO_2H$

$$R'\text{-}CO_2H \rightarrow {}^{\bullet}OH + R'\text{-}CO^{\bullet}$$
$$R'\text{-}CO^{\bullet} + R''H \rightarrow R'\text{-}CO\text{-}R'' + H^{\bullet}$$

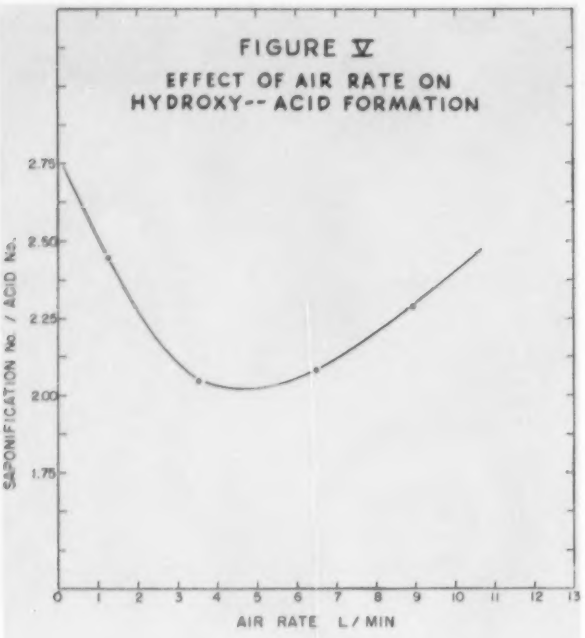
or, $CH_2\text{-}CO^{\bullet} \rightarrow$ (cyclic) $+ H^{\bullet}$

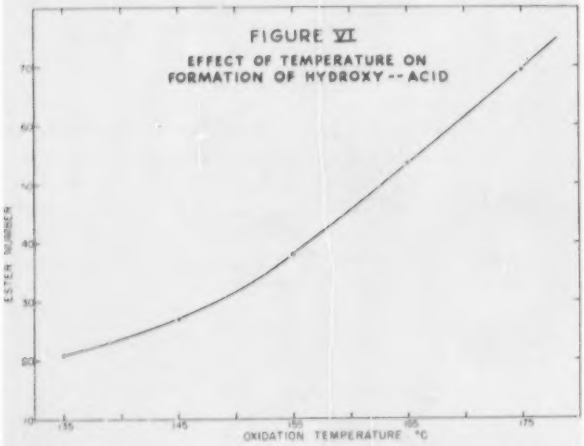
Pardun and Kuchinka[7] found that the ratio of esters to free acid is essentially constant and completely independent of the degree of oxidation within fairly wide limits. They concluded that the formation of lactone-forming hydroxy-acids as well as the formation of fatty acids is connected with the primary process of peroxide decomposition.

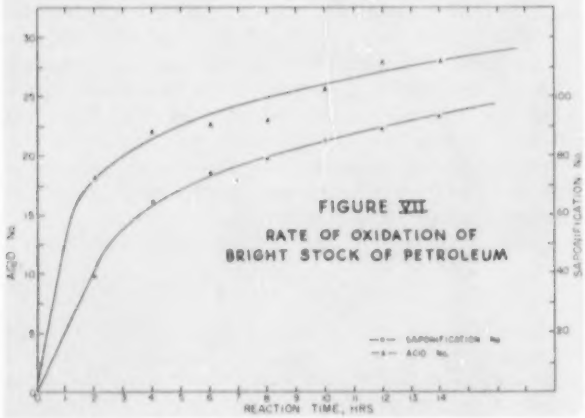
Formation of an ester or lactone by reaction of an acylperoxy radical is in agreement with the following reaction reported by Boeseken[9]:

$$C_6H_5\text{-}CO\text{-}O\text{-}O\text{-}CO\text{-}C_6H_5 + RH \rightarrow CO_2 + C_6H_5\text{-}CO\text{-}OR + C_6H_6$$

The interrelation of acid and ester formation is well illustrated by Figures IV and VII. A good rule of thumb for a catalyzed oxidation of paraffin wax is that the saponification number is always approximately twice the acid







number; or, in other words, a mole of ester is formed for each mole of acid formed. The above sequence of reactions produces ester and free acid in this ratio.

When petrolatum is oxidized, the proportion of lactones and esters is much higher. This is believed to be due to the increased branching in petrolatum. Tertiary hydroperoxides are preferentially formed and decompose to give relatively stable ketones and alcohols. Free acids are then esterified by these alcohols.

Figure VI shows that the proportion of hydroxy acids also increases with oxidation temperature. This is explained by an increase in the rate of thermal decomposition of hydroperoxides. Farmer[10] states that thermal decomposition leads to formation of hydroxy compounds while catalytic decomposition is especially characterized by the formation of carboxyl compounds.

The formation of peracids from aldehydes (steps 3a and b) is catalyzed by the transition metals[11].

The Role of Metal Catalysts

Colloidal manganese dioxide[12] or manganous oxide[13] has been shown to give reactions typical of an oxydase. In other words, these can act as oxygen carriers in oxidation reactions. This picture of the function of manganese dioxide is equivalent to the mechanism given by George (Step 1) for formation of hydroperoxides. Pardun and Kuchinka prefer to believe that the ability of certain metals to function as catalysts is related to their ability to form labile peroxides and act as oxygen carriers. When manganese naphthenate or manganese dioxide is used as catalyst, the reaction mixture which is originally quite dark becomes colorless soon after oxidation begins. This change in color is probably associated with a change in valence. It has been reported that in the use of manganese naphthenate as a "drier", no oxidation occurs until some of the manganous ion is oxidized to manganate ion, the change in valence being evidenced by a disappearance of the pink color[14]. In the case of manganese dioxide, this change does not involve formation of oil-soluble derivatives, since filtration completely removed manganese.

Manganese dioxide also apparently catalyzes decomposition of peroxides, since it produces a constant maximum oxidation rate with increasing concentration.

The fact that zinc can form peroxides[15] may account for the ability of its salts to function as oxidation catalysts.

2. Preparation of Greases from Oxidized Wax

Experimental batches of grease were prepared using oxidized wax of widely varying characteristics. In order to determine suitability and superiority, batches were first prepared in which the nature of the oxidized wax was the only variable. In this manner, it was possible to determine the most suitable wax base for oxidation and the most satisfactory oxidation process. In general, normal procedures were used in which the saponifiable base was combined with the proper amount of the desired saponifying agent and the resultant soap base processed so as to produce a grease. The equipment used was the conventional laboratory and pilot plant experimental kettles of both open and closed types. For preliminary studies, batches of six-pound and twelve-pound size were usually pre-

pared. These were followed by two-hundred pound batches where results justified further investigation.

In view of the varying characteristics of the oxidized wax bases which were used, processing conditions such as maximum temperature, time, etc., were necessarily varied accordingly. Since a general evaluation of the various oxidized bases was required, greases were prepared or their preparation attempted, with sodium, calcium, lithium, barium aluminum, and mixed sodium-calcium base. These will be discussed in order with particular emphasis upon the sodium and lithium base.

Sodium Base Grease

In general, it was found that the oxidized wax base was most amenable to a soda base grease. Regardless of level of oxidation, some form of grease would result, but with widely varying properties. Best results were secured with a base of intermediate level oxidation having an acid number of 70-90 and saponification number of 140-180. Using this base, a grease of the following typical characteristics was prepared:

GREASE "A"

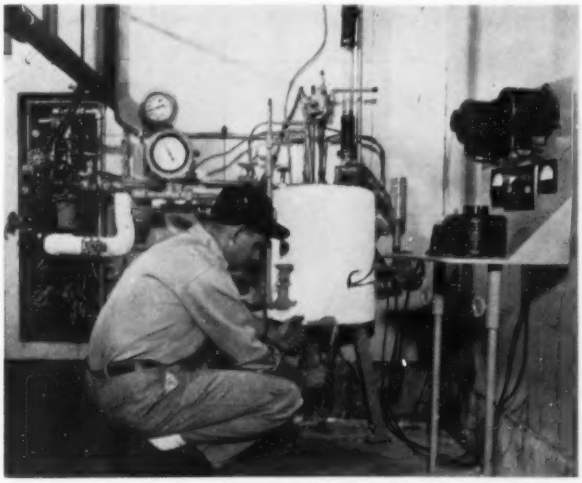
Mineral Oil	500 at 100 S.S.U.-50 V. I.
A.S.T.M. Pen. 60 Strokes	280 (10,000 strokes 340)
A.S.T.M. Dropping Point °F	465
Free Alk. as NaOH	0.05%
Soap (based on oxidized wax)	20-21%
Water Resistance (boiling H_2O)	Poor
Separation	2.0%
Evaporation	0.5%
Oxidation Stability	Poor (without anti-oxidant)
Wheel Bearing Test	Good
Corrosion Resistance	Good
Texture	Gel-like, non-fibrous
Color	Dark greenish-brown
Odor	Of oxidized hydrocarbon

The above grease was selected for an extensive service test in general plant lubrication, particularly for those locations which were not susceptible to moisture and where operating temperatures were high. One such location is the motors used in solvent treating operations which have been found to be particularly difficult to lubricate. Lubricants which had been previously used often resulted in lost bearings. The experimental grease prepared with a 100 per cent oxidized wax base has been used for this service for a period of approximately three years with completely satisfactory results and no lost bearings.

In the accompanying electron micrographs, it will be observed that sodium base greases made with straight oxidized wax generally have little tendency toward fiber structure. However, at the intermediate level of oxidation, a slight fiber can be noticed. This might account for the somewhat better behavior of this grease base (Plate I.) A characteristic gel-like texture, which is exceedingly thixotropic in character, develops in all cases. Normal fats and fatty acids can be admixed with the oxidized wax in any proportion and will alter the texture and other characteristics accordingly. Plate II shows the effect of 30 per cent of added tallow.

Calcium Base

Calcium base greases were found difficult to handle and impossible to prepare by the normal procedure for lime base greases. By using a low V. I. naphthenic type oil and by preparing a dehydrated grease, it was possible to obtain a grease which appeared to have normal characteristics. Structure stability was exceedingly weak, however, and the grease retained its structure for only a short period of time after which it reverted to a thin soupy consistency. Plate III shows no evidence of any fiber or other basic grease structure. In combination with normal fats and fatty acids, this same condition prevailed up to the point of practical elimination. No particular study was made of a structure stabilizer for this combination, and it is quite possible that such might eventually be found.



Pictured here is a small pilot plant for wax oxidation.

This shows small scale preparation of a grease from oxidized wax.

Mixed Base Sodium-Calcium

A mixed sodium-calcium base grease in the generally used base ratio of 85/15 was found to have some interesting possibilities. Plate IV shows a typical grease of this type. Tendency toward fiber formation appears to be somewhat increased over that of either sodium or calcium alone. This grease, likewise, forms a gel-like texture which is very thixotropic in nature. There is no apparent fiber in the usual sense. The grease has a dropping point somewhat higher than that of normal mixed base grease, but is exceedingly susceptible to water. With higher ratios of calcium to sodium, the tendency toward improvement decreased until at fifty per cent the grease approached the non-stable gel characteristic of the straight calcium grease.

Physical characteristics of the mixed base grease were fairly comparable to those of sodium in respect to texture, yield, oxidation stability, melting point, and shear stability.

Barium Base

No favorable results were obtained with barium greases with any of the oxidized bases, regardless of level of oxidation or type of mineral oil used. In all cases, a hard granular soap resulted which could not be dispersed.

Aluminum Base

Aluminum base soaps were prepared by double decomposition methods from many of the oxidized bases. In all cases, the soaps so prepared did not compare favorably with the normal fatty acid soaps in either solubility or gel characteristics. It was apparent that this was due to the large quantity of mineral oil-insoluble soaps resulting from the highly oxidized portions. By admixing the oxidized wax with normal fatty acids, soaps could be prepared which would approach the normal aluminum soaps in grease forming characteristics. It was apparent that to obtain an aluminum soap of normal solubility and gel strength a more drastically refined and separated base would be required.

Attempts to use the total saponifiable material in oxidized wax, after extraction of unsaponifiables, were very unsatisfactory. Under the same conditions which yield freeflowing, oil-soluble soaps with the free acid portion of oxidized wax, the total saponifiable portion gives a high ash, dark, oil-insoluble soap.

Fairly good soaps were made from the free acid portion by washing a hydrocarbon solution of oxidized wax with an aqueous solution containing only enough caustic to neutralize the free acids. Figure VIII compares the free acid and ash content of aluminum soaps of free acids from oxidized wax with aluminum stearate prepared in the same manner using various amounts of excess caustic. It can be seen that the free acid content of oxidized wax soaps is much higher and the ash content is somewhat lower than with aluminum stearate. Oxidized wax soaps prepared using 100% excess caustic were oil-soluble, while the use of 150% excess caustic produced oil-insoluble soaps. None of these approached the gelling efficiency of aluminum stearate. An additional difficulty is that the use of excess caustic leads to darkening and necessitates bleaching the sodium soap.

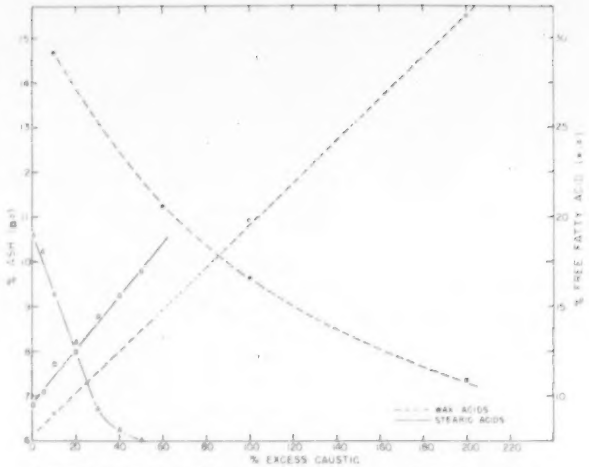


Fig VIII EFFECT OF EXCESS CAUSTIC ON ASH AND FREE ACID CONTENT

Lithium Base

Lithium base greases made with oxidized wax were found to be the most versatile. Either straight or combined with normal fats and fatty acids, they lend themselves to a variety of greases of widely varying properties. Since these greases were intended for multi-purpose use, they were examined with those properties in mind. Straight oxidized wax base produces a grease of poor water resistance. By combining the oxidized wax with some of the normal fats and fatty acids, it is possible to produce a grease of greatly improved characteristics. As little as 25% of a grease base such as hydrogenated tallow fatty acids gives a grease of satisfactory water resistance. As the degree of unsaturation of the admixed fatty material increases, the water susceptibility increases.

Straight oxidized wax produces a gel-like texture somewhat similar to the sodium base greases and with similar thixotropic properties. With admixed normal fats, the texture becomes more normal with less thixotropic tendency. Plate V shows a lithium grease made with straight oxidized wax, and Plate VI shows one from 25% of hydrogenated tallow acids and 75% oxidized wax. Some fiber structure is evidenced in the straight oxidized wax base. The addition of as little as 10% of normal fat shows a pronounced increase in fiber formation, and likewise results in an improved texture and better physical characteristics.

Two greases typical of the above formulations show characteristics as follows:

	"B"	"C"
Mineral Oil	1200 at 100	S.S.U.-50 V.I.
Soap Base	50% Oxidized Wax 50% Hydrogenated Tallow F.A.	75% Oxidized Wax 25% Hydrogenated Tallow F.A.
A.S.T.M. Pen. Worked	280	280
10,000 Strokes	350	345
A.S.T.M. Dropping Point	376°F.	365°F.
Free Alk. as LiOH	0.04%	0.05%
Soap (Total Base)	13.0%	16.0%
Separation	2.0%	2.5%
Evaporation	None	None

Oxidation Stability	Poor (without anti-oxidant)	Poor (without anti-oxidant)
Water Resistance (Boiling H_2O)	Good	Good
Corrosion Resistance	Good	Good
Texture	Smooth Gel	Smooth Gel
Color	Dark Greenish-brown	Dark Greenish-brown
Odor	Oxidized Hydro-carbon	Oxidized Hydro-carbon
Wheel Bearing Test	Very Good	Very Good

Both of the above greases were used for general all-purpose lubrication in Continental's entire Ponca City fleet consisting of cars, trucks, tractors, and all motorized equipment for a period of two years with remarkably good results. As this was not a test for evaluation of various multi-purpose greases, the results were compared with those of the best greases previously used for similar operations. A general resumé indicated complete and adequate lubrication with a considerably reduced volume of grease. During this test more than one hundred units traveled a distance of approximately two and one-half million miles.

Discussion

An oxidized wax base of 140-180 saponification number and 70-90 acid number resulting from the oxidation of a wax from 400 Pale Oil operations was found most satisfactory for the preparation of greases. Sodium and lithium base greases, which were comparable in many respects to those made with normal fats and fatty acids were prepared. General characteristics of the greases and the effect of variations in raw materials were as follows:

Mineral Oils

Mineral oils of widely varying characteristics, both in viscosity and viscosity index, were used. As would be expected, the highly paraffinic oils were the most difficult to handle, and gave the least satisfactory results. The low or medium V. I. naphthenic oils gave the most satisfactory results.

Soap Base

Oxidized wax may be used straight or in combination with normal fats and fatty acids. For some applications, a straight oxidized wax base grease is completely satisfactory. In most cases, however, the admixture with normal fats and fatty acids improves the overall characteristics.

Yields

Yields were generally low based on the total amount of soap-forming base. This was believed to be due to the lack of any definite soap structure. With the addition of normal fats and fatty acids, definite soap structure became apparent with improvement in both yields and overall grease characteristics. In general, about 50% more soap was required for consistencies comparable to those obtained with normal fats.

Texture

A gel-like texture appears to be common for the various greases made with straight oxidized wax, but in some cases it is extremely thixotropic. This texture can be altered to a considerable extent by admixture with normal fats and fatty acids, and by addition of various modifying agents.

Mechanical Stability

Stability to working is fair. A typical sodium base grease made with straight oxidized wax showed an increase in penetration from 300 to 350 upon working 100,000 strokes. The lithium grease exhibits the same order of stability.

Storage Stability

Storage stability of oxidized wax base greases varies greatly. A sodium base grease, such as that shown in example A, has changed only slightly after three-years storage, except for the usual initial hardening. Other greases have shown considerable bleeding and hard gel formation on prolonged standing. This dissimilarity appears to result from variations in the composition of the oxidized base as well as from the type of soap used.

Oxidation Stability

Without the use of inhibitors, the oxidation stability of greases made with oxidized wax is very poor as measured by the Norma-Hoffman method. Response to in-

Above—A part of the Ponca City, Oklahoma fleet which was used in service testing these greases.

Left—Periodic examination of wheel bearings. Author Kirk is at the extreme left and author Nelson at the extreme right.

hibitors is likewise poor and unpredictable. In spite of this condition, oxidized wax base greases have performed satisfactorily in some services without any apparent tendency toward oxidation or instability.

Dropping Point

The dropping point of oxidized wax base grease is usually somewhat higher than that of comparable greases made with normal fats. This is particularly true of the sodium and sodium-calcium bases.

Corrosion

Oxidized wax base greases, when properly combined, show no tendency toward corrosion, either at room temperature or at 212°F.

Water Resistance

All straight oxidized wax base greases exhibited considerable water susceptibility. With a lithium grease, the addition of 25% of a normal fat having a low iodine value produced good water resistance.

Color

Most of the greases made with oxidized wax base are dark. This color appears to result from the reaction of alkali with carbonyl compounds in the oxidized wax. If dark colored oils are used, this is of little significance.

Odor

Oxidized wax has a characteristic odor which persists through most stages of handling, and is apparent in lubricating greases made therewith. While the odor might be termed unpleasant or objectionable, it certainly is no worse than many low-grade fats which are used in greases. Only drastic refining will eliminate this characteristic odor.

Summary

1. Petroleum wax can be oxidized to form a saponifiable base which may be used for the production of lubricating greases.
2. An oxidation process using manganese dioxide and zinc stearate as catalyst has been found suitable for oxidizing petroleum wax.
3. Formation of hydroxy acids and free acids in approximately the same ratio over a wide range of degree of oxidation indicates an inter-relation between formation of the two types of acids. A mechanism for wax oxidation has been proposed which is consistent with the results obtained.
4. Sodium and lithium soaps gave the best results with an oxidized wax base. The mixed sodium-calcium base also gave indication of some merit.
5. While the oxidized wax may be used as such, considerably better results can be secured by admixture with normal fats and fatty acids.
6. Yields are low in comparison with similar greases made with normal fats. In general, a 50% increase in soap base is required to obtain comparable consistencies.
7. Performance characteristics vary considerably. A sodium base grease made with a straight oxidized wax base has given excellent results in high temperature service.

A lithium base grease made from 75% of oxidized wax and 25% hydrogenated tallow fatty acid has given excellent results as a multi-purpose lubricant.

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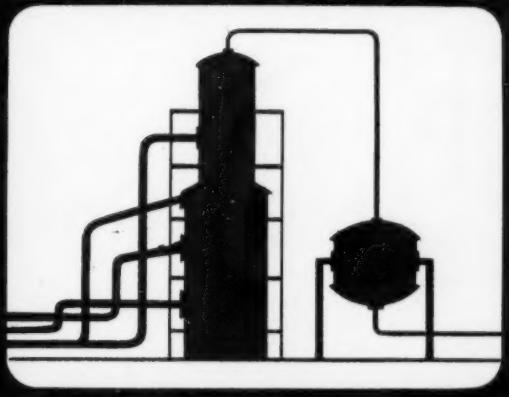

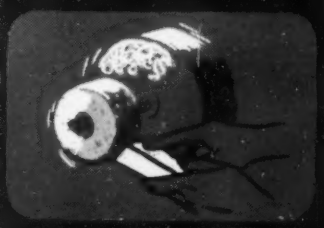

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North Tonawanda, New York

Until close to 1800 the universal lubricant was beef or mutton tallow or a vegetable oil. It was not until after Drake drilled his first well that we find any record of lubricating grease, as we know it today, being manufactured. A commonly accepted definition of lubricating grease is "a combination of soap or mixture of soaps and a petroleum product suitable for lubrication." A more recent suggested definition is "a solid to semi-solid product of the dispersion of a thickening agent in a liquid lubricant. Other ingredients imparting special properties may be included."

In decades past lubrication presented no great problem. However, mechanical developments in more recent years have changed this picture, and today proper lubrication and application of lubricants is of extreme importance to industrial progress.

As a user or consumer of lubricating grease, one's interest lies in being able to recognize the grease by type or kind and what to expect from the product chosen. To do this, one must have some basic knowledge about the product.

Lubricating greases are produced in many types and forms, some very simple in formulation and some highly technical and complex. There is very little question as to the versatility or advantage of lubricating grease over straight lubricating oils, when the proper grade or type is chosen and properly applied. At this time, we will talk about the types in general use for average lubrication requirements, and place these lubricants in four general classifications, keeping in mind the information is general and covers average normal use and products.

1. Water-resistant type for applications from below zero to approximately 180°F. operating temperatures. This classification takes into consideration, generally, calcium and aluminum base greases.

2. Water-soluble type for applications from average operating temperatures above freezing to temperatures ranging up to 300/400°F. and over—generally the soda base greases.

3. Multi-purpose greases—water-resistant types—covering both low and high temperature applications.

4. Greases using synthetic fluids in place of natural mineral oils.

In addition, we will discuss briefly additives, fillers and the value of the more common physical test procedures.

Classification No. 1

Water-resistant type, generally calcium and aluminum base

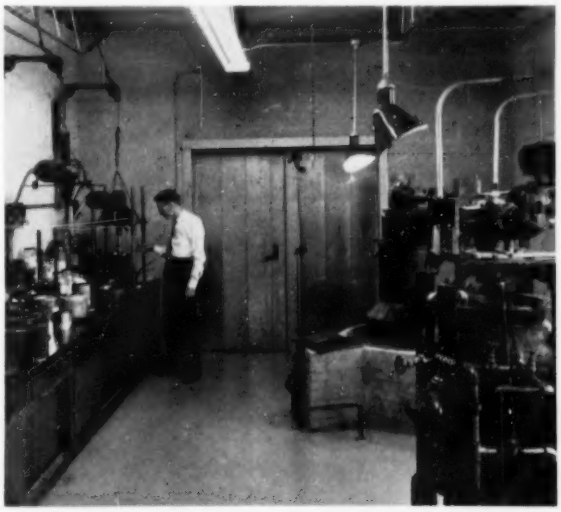
Our first discussion will cover the normal calcium base grease. This type is produced by the saponification or cooking, with steam or open fire as a heating medium, a soap base composed of whole fat such as tallow, or fatty acids, with lime and water. After this base is completed, the chosen mineral or lubricating oil is slowly added along with the required amount of water to form the necessary emulsion of base and oil—the total amount of mineral oil added to the base determining the body or consistency of the finished grease. Using the N.L.G.I. numbering method, the No. 1 of course will be the softer grade, increasing in body as the numbers rise. A No. 1 grease normally will run approximately 90% lubricating oil, a trace to 2% water and about 10% soap, with worked penetration of 310/340 while a No. 5, which is a very stiff grade, may run 25/30% soap, water up to 2½ to 3%, and the balance lubricating oil, with worked penetration 130/160. The viscosity of the oil of course may run anywhere from 30/35 seconds Saybolt at 100 to 5000 or

over, and the V. I. from below 0 to 100 plus. The use to which the grease is to be put will of course determine its body or consistency and the viscosity and V. I. of the lubricating oil used in it.

Assuming that only quality fats of the proper type and well-refined lubricating oils are used, the selection, then, of a calcium grease is governed by a few fundamentals; namely, the temperature at which the grease is to operate, the type of bearing, the speed of the bearing, the clearance, the pressure, and the frequency of lubrication.

For temperatures below freezing and below zero, a very light viscosity, high viscosity index lubricating oil should be used. Where temperatures are generally above freezing, a heavier viscosity oil is more desirable and high viscosity index of the oil of less importance. Likewise the size and speed of the bearing and pressure involved also determine the viscosity of the oil and the consistency of the grease. It is safe to say that for normal requirements, the viscosity of the oil in the lubricating grease one decides to use should be about the same as if straight oils were used. One must keep in mind that lubricating grease is in reality a gelled oil and it is actually the oil that is doing most of the lubricating, although aided by the soap, and is kept in place by the soap from which the grease is produced.

Generally speaking, in selecting calcium greases, we should keep in mind that for very low temperatures a very light viscosity, high viscosity index oil should be used; for average temperatures a medium viscosity oil—perhaps in the SAE 20/30 range; and for higher temperatures and pressures reaching the maximum safety for calcium greases, oils in the SAE 50/70 range or even higher with medium range viscosity index should be used.



This is equipment used in developing lubricating greases. (Photo courtesy Battenfeld Grease and Oil Corporation)

Selection of consistency and oil viscosity depends, also, on the speed of the bearing and the design of the bearing, whether sealed or open and whether sleeve-type or anti-friction. For open-type sleeve bearings, heavier oil viscosity and consistencies in the No. 2 and No. 3 range are preferable. For sleeve-type bearings, well sealed, No. 1 and No. 2 consistencies are preferable. Where dirt, dust and water are encountered, the heavier body grease is preferred because of its better sealing ability. For anti-friction bearings, the medium viscosity oils are preferable and for normal speeds the No. 1 and No. 2 consistency range—for higher speeds and temperatures, No. 2 and No. 3 consistency, and higher viscosity oil, keeping in mind not to overfill the bearings at any time.

The most important factor to keep in mind when selecting a calcium base grease is that the normal calcium base greases generally are not safe to use for extended periods of time where operating temperatures will cause rapid evaporation or loss of the water content of the grease. The reason is very simple. Calcium base greases normally are a mechanical mixture or emulsion of soap, oil and water. Elevated temperatures tend to evaporate the water, which acts as a binder of the soap and oil, allowing the oil to separate readily and bleed away from the bearing leaving behind a heavy, sticky mass of soap which soon causes difficulty, especially in anti-friction bearings which normally are not lubricated as often as the sleeve-type bearing.

Where temperatures in an elevated range are consistent or extremes of temperature from low to high are encountered and it is desired to use calcium grease, possibly due to water resistance and ease of application, some of the difficulty due to separation can be overcome by frequent greasings, flushing out the old grease and replacing with new and fresh grease.

We might add, the type of fat used in the production of a lime base grease also determines its utility at elevated temperatures. As a rule, grease manufactured from fatty acids will give better service at elevated temperatures than grease produced from whole fats. There is less tendency for bleeding or oil separation when using the fatty acid type grease compared with the whole fat type grease.

The color of the grease has nothing to do with its ability to perform or not to perform, providing refined oils are used, and is mainly psychological to the user. Normal greases are not dyed but obtain their color from the color of the lubricating oils and fats used in their production. In some rare instances, dyes are used to color greases as a brand identification.

Calcium base greases are good low temperature lubricants and when we speak of low temperature we mean temperatures from possibly freezing to well below zero.

In selecting a calcium grease for low temperature lubrication, viscosity, V. I. and pour point of the oil used in the grease are extremely important. Consistency and soap structure follow. The proper type of fat must be used for best results and the water content must be reduced to a trace. Such greases are available for low temperature lubrication, but are not recommended for use where the conditions, although involving a period of very low temperature operation may also involve periods of high temperature operation, too, because of possible physical change of the grease due to moisture loss, and extreme thinning and evaporation tendency of the light viscosity oils generally used in this type grease.

The second type of grease in this classification is aluminum base grease.

Aluminum base greases are very similar to calcium base

greases in their general structure and physical characteristics. The manufacture differs somewhat from calcium base grease, although the general procedure is the same. Melting points are in about the same range, although aluminum greases can be used at slightly higher temperatures than calcium base greases due to the fact that they are water-free and will not separate due to loss of moisture.

Aluminum base greases may have an advantage over some types of calcium greases due to the fact that there is slightly less tendency for them to bleed oil and, therefore, for lubrication where some oil bleeding or capillary action would be detrimental—as in the lubrication of instruments, some canning equipment, certain textile machinery—aluminum base types may prove more satisfactory.

Classification No. 2

Water-soluble type—generally soda base

This classification covers the normal soda base or what is sometimes known as sponge or fibre grease. Like calcium grease, this type product is produced from whole fats or fatty acids, water and lubricating oil, but caustic soda (sodium hydroxide) is used in place of lime. The manufacture of soda base grease is very similar to that of calcium. Soda grease differs from calcium grease in that it is more nearly a chemical mixture of soap and oil and does not depend entirely on its water content to maintain its gell or grease structure; in fact, the lower the water content in a soda base grease the better the grease. An excess of water generally causes the grease to become soft and lose its normal consistency under operating conditions or storage. We might add at this time that the nomenclature sponge or fibre is derived, not from the addition or fillers to the grease, but from its appearance due to the method of manufacture and raw materials used.

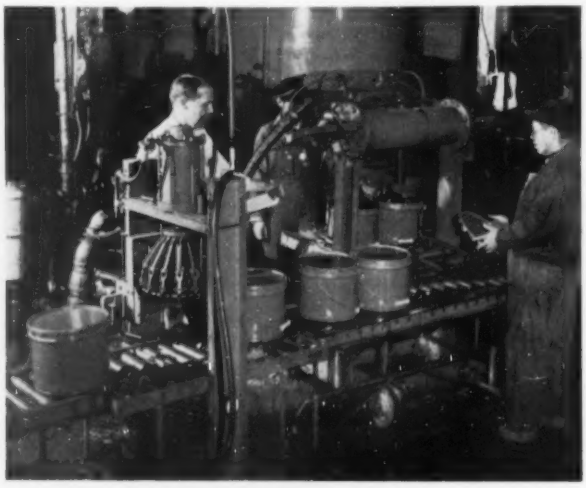
Soda base greases can be used as low temperature lubricants depending upon the viscosity and V. I. of the oil used and consistency and type fats used to formulate the base. When using them as low temperature greases, great care must be taken in their selection. Generally, below freezing and invariably below zero, even with light viscosity oils, soda base greases become very stiff and difficult to pump creating high starting torques and in the case of small anti-friction bearings preventing bearing movement entirely.

Taking into consideration the frequency of lubrication periods, the safe high temperature limit of operation with a soda base grease is very close to its actual melting or dropping point. Again, the proper consistency depends upon the size of the bearing, clearance, speed, pressure, operating temperatures and frequency of lubrication. The general outline for selecting a calcium grease can be followed closely for soda greases with the exception that soda greases are not so desirable at temperatures below freezing, do give satisfactory lubrication at elevated temperatures well above 300°F., and should always be questioned when used in contact with water or steam.

Another fact to take into consideration in the selection of a soda base grease is its general structural appearance, whether a short, buttery type or a long, stringy, fibrous type. It is generally accepted that the short, buttery types of grease are most desirable for anti-friction bearings and general sleeve-type bearing lubrication due to the fact that there is less resistance to shear in the short fibred structure and less breakdown of the grease due to operation of the bearing. For bearings such as coupler type, universal joints, etc. where throw-off due to centrifugal force is a factor, the stringy, long-fibred types are most desirable as the fibres tend to wind around the moving parts and thus resist throw-off.

Soda base greases are, of course, normally water soluble. However, the solubility of soda base greases can be modified to give some degree of water resistance depending on the type of fat and the viscosity and type of mineral oil used. Certain additives can also be used to decrease solubility.

In using a soda base grease under elevated temperatures, care must be taken to choose grease that will not bleed oil or thicken excessively due to oil evaporation. There-



Shown at left is the manufacturing of lubricating greases. Pictured at right is filling lubricating grease into packages. (Photos courtesy Battenfeld Grease and Oil Corporation)

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fore, it is necessary to determine the optimum temperature and speed at which a bearing will operate over a long period of time and then choose the grease accordingly. Keep in mind the fact that the lighter viscosity and high V.I. oils will have a greater tendency to bleed under operating and storage conditions than the medium or heavy viscosity oils of lower V. I.

Milled or Preworked Grease

Another important factor that must be given consideration in the selection of a grease lubricant, especially soda base greases, is the difference between its unworked and worked penetration. This is a greater factor in soda base than in calcium or aluminum base greases.

The softer grades—No. 0 to No. 2 consistencies—in calcium or aluminum greases are not affected to a great extent by the action of a properly lubricated bearing. However, the heavier consistencies—No. 3, No. 4, No. 5 and over—do show a large range between worked and unworked consistency and must be taken into consideration.

Soda base greases differ, however, in that practically all consistencies will show a marked breakdown in consistency or body on working.

To overcome this undesirable characteristic, greases of all types and especially soda base greases can be produced with higher than normal soap contents and then, when cool, milled or cold worked to the desired consistency for efficient bearing operation.

This preworking adds hours of life to the lubricant—less frequent greasings required—better sealing of the bearing obtained—less tendency to bleed—and a lower shear and torque. The milling operation predigests the grease to fit the bearing's appetite.

However, there may be certain applications where an unmilled grease should be considered if it can be applied properly. It may be desirable to have the grease which is retained within the bearing break to a soft plastic, forcing the stiffer unworked grease out to form a stiff shock-resistant seal.

Classification No. 3

Multi-Purpose Greases

The next classification covers the newer type multi-purpose greases which are being marketed today under various trade names and produced, generally, from either barium or lithium soaps, or the more recently developed non-soap gelling agents.

In recent years industry, as well as the automotive field, became overburdened and confused by a seemingly endless array of special purpose lubricating greases. Spurred on by the obvious benefits which would result if this situation could be alleviated—benefits such as reduced inventories of greases, reduction or elimination of problems resulting from application of the wrong grease, lapse of lubrication because special products were not available, reduction of types and quantities of dispensing equipment, better housekeeping—the development and acceptance of the multi-purpose lubricating greases were rapid indeed.

In general, multi-purpose greases—to be classed as such—must possess the following general characteristics:

1. Good work or shear stability.
2. Usable over wide temperature range.
3. Good water resistance.
4. Physical structure acceptable for all types of bearings and satisfactory for use in dispensing equipment.

The barium base grease in general use is of a short, fibrous nature in appearance. It is highly water resistant, has a dropping point ranging about 400°F. and shows

Pictured at right is lubricating grease being tested for shear stability in Shell Roll apparatus. Shown in picture below is testing equipment for wheel bearing lubricating greases. (Photos courtesy Battenfeld Grease and Oil Corporation)

very little breakdown under working. These properties put it in the class of the multi-purpose lubricant as, generally, only one consistency product is required.

Barium greases are applicable over wide temperature ranges and have proven to be exceptionally successful for high temperature lubrication.

Barium greases have good tenacity for metal surfaces resulting in superior adhesion to surfaces and retention in bearings.

The good grades of lithium base greases, also, possess the qualifications of a multi-purpose grease, namely mechanical stability, water resistance and stability over wide temperature ranges.

The dropping point of lithium grease is lower than that of barium grease—about 350°F. Due to its smooth, buttery nature and physical properties of lithium soaps, it is somewhat superior to barium greases for very low temperature applications. This same characteristic, also, makes handling and dispensing of lithium greases somewhat easier.

The work stability of lithium greases is excellent and proper selection of raw materials for lithium grease manufacture has resulted in production of the most mechanically stable lubricating grease available to date.

It should be mentioned that, due to their unusual properties, various grades of both barium and lithium greases —other than the multi-purpose grade—are produced to meet certain specific problems.

The most recently developed thickeners for manufacturing lubricating greases are the so-called inorganic gell agents comprising specially purified and treated clays (Bentone and Permagel) and fine particle silica.

Lubricating greases produced from these materials have an outstanding characteristic—they have no melting or dropping point. Even when exposed to blow torch heat they do not melt or drip. These products, therefore, are very successful at extremely high temperatures. However, caution must be exercised, for since the grease does not melt, the flash point, evaporation point or coking point of the oil contained in the grease becomes the critical feature in these products. The tendency, if used at temperatures approaching the critical constants mentioned above of the oil, is to become gummy or hard, eventually forming a coke unless proper re-greasing and flushing intervals are established and observed.

The low temperature characteristics of these gell type products are directly related to oil viscosity and pour point and to grease consistency. Since they do not contain soaps, which themselves become harder and more viscous at low temperatures, the gell type greases are somewhat superior to barium and lithium greases for extreme low temperature applications.

These lubricants are of smooth, buttery structure, putting them on a par with lithium greases from a handling and dispensing standpoint. Their mechanical stability is also very good.

The bentone greases are very water tolerant being capable of absorbing considerable quantities of water without noticeable change in consistency. Permagel and silica products must be specially treated to prevent water attack, such treatment being reasonably successful. However, from a water resistance or tolerance standpoint, the latter two products are the poorest in the multi-purpose class.

Classification No. 4

Synthetic Greases

Perhaps the newest development in lubricating grease is the so-called synthetic greases.

These products are produced in most cases by the use of normal types of soaps or gell agents but substituting the synthetic types of hydrocarbons for normal mineral oils.

The greases have great possibilities in both low and high temperature operations and are produced in both water soluble and insoluble types in many consistency ranges and viscosity ranges of the fluids.

If a lubrication problem is one of wide temperature variation, rapid oxidation, gumming etc., the synthetic product will be of great interest. Many of them, unlike normal greases, have little or no effect on natural or synthetic rubber.

Due to the extremely high viscosity index and low evaporation point of some of the synthetic fluids, ideal combination low and high temperature greases are produced.

The high temperature greases lubricate at elevated temperatures over extended periods of time without leaving a residual deposit usually found when using normal greases.

The Value of Physical Tests vs. Performance

The question of whether physical and chemical tests are an aid in the proper selection of a grease lubricant is often asked.

Conventional physical and chemical tests are excellent for controlling the uniformity in manufacture—and even for that purpose such controls have their limitations. Two greases with identical physical tests may give different results when placed in a bearing under identical operating conditions. In addition to physical tests, there must be correlated performance tests that really give the right answers. A regular ASTM worked penetration taken at 60 strokes and 77° F. means very little as to performance. Some value, however, can be placed on this test provided a correlation is worked out between an unworked and worked penetration which may give some indication of the breakdown in structure during bearing operation. This would be only an indicative figure and could not be relied upon as a definite answer to performance. Accelerated tests to give such answers have been set up and are proving of value in the selection of the proper lubricant for a specific operation.

The ASTM melting or dropping point, viscosity index of the lubricating oil acidity, alkalinity and the numerous other physical and chemical tests are all good indications and controls but in reality mean very little in the way of actual performance.

Additives for Lubricating Greases

For bearings operating at higher temperatures and heavier loads than normal, oxidation inhibitors and extreme pressure additives are available.

Oxidation inhibitors also act somewhat as a stabilizer and rust preventive by inhibiting the actions that may be the cause of bearing corrosion.

For heavier than normal loads, there are many types of extreme pressure additives available and some thought must be given to their proper selection.

With a known load, speed and bearing size it is not difficult to determine if an E. P. grease is required. Keep in mind that grease in itself has much greater load carrying capacity than the oil it contains or the straight oil one may be using.

In selecting the proper extreme pressure additive, take into consideration bearing structure, composition and atmospheric conditions. All of these will react on the chemical used. Wear factor is an important phase that can at times be traced back to the activity of the additive.

Fillers

Fillers are commonly used in many greases for special operating conditions. Such fillers as graphite, carbon black, mica, lead, zinc, molybdenum disulphide, and other compounds find their way into special formulations to impart what we might term "solid lubrication."

Fillers of the above-mentioned types are desirable where extremely heavy loads and intermittent starting and stopping are encountered—or shock loads such as in steel mill roll bearings, rubber mills, etc. Starting torque and bearing wear are greatly reduced in such operations by the use of the so-called solid type lubrication obtained through the use of fillers. The filler forms a solid film between the metal parts of the bearing and is not squeezed out during shutdown or shock.

Application

Proper application is as important as choosing the proper lubricant.

The necessary frequency of lubrication periods is easily charted, if one give due consideration to the many fac-

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tors involved and already mentioned.

The method of application will determine somewhat the consistency. Grease cup and hand guns allow the use of heavier-bodied or unworked greases. Automatic greasing units call for softer consistencies for satisfactory operation.

Should the bearing call for a heavier body than the lubrication system will handle, a well-milled grease may be the answer.

Over-lubrication is as dangerous as under-lubrication. Do not force the bearing to do extra work, creating added heat and friction with possible lubrication and bearing failure.

Summary

To summarize, there is no mystery or difficulty connected with the selection of a lubricating grease to lubricate properly the majority of bearings in operation—where a grease-type lubricant can be used to greater satisfaction than a straight oil.

No product, whether it is steel, wood, paint or lubricating grease, will give service beyond the physical properties inherent in that product. If the requirement goes beyond that point—research, development and further engineering are involved and the application becomes a special problem.

It may be that other conditions beyond the bearing and equipment may have to be taken into consideration in such development—atmospheric conditions—product contamination—contamination of the lubricant by the product—accessibility of the bearing for frequent lubrication—heat other than that generated by the operation itself. All of these factors are involved where special application is indicated.

Many bearings now operating on oil lubrication can be more satisfactorily grease lubricated with a resulting increase in bearing life, cost reduction and safety factor.

In selecting the proper lubricant, do not guess. Have all the facts—type and size of bearing, speed, clearance at normal and at operating temperature, maximum operating pressure in P.S.I., maximum high or low temperature, frequency of lubrication periods, possible contamination by product or atmosphere.

The problem becomes greatly simplified and can be further simplified if sufficient thought is given to lubrication by the design engineer of both equipment and bearings.

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Patents and Developments

Sulfurized Greases

Greases which contain sulfurized metal soap thickeners acting as non-corrosive extreme pressure agents without need of secondary additives ordinarily employed, are disclosed in U. S. Patent 2,666,744 issued to California Research Corporation.

The sulfurized metal soaps used are those of fatty acids having 1–3 double bonds per fatty acid anion. It is preferred that the fatty acid anions contain only one double bond. The unsaturated fatty acids used in the soaps include the straight or branched chain unsaturated fatty acids containing 9–30 carbon atoms. Metals for the soaps include those in Groups I, II and III of the periodic table.

The sulfur is present in an amount of 0.25–1.0 atom per double bond of the acid. This is critical, since if the value exceeds 1.0, the resulting grease tends to bleed and deteriorate rapidly. In the case of calcium soaps, the sulfur is preferred in an amount of 0.3–0.5 atom per double bond, whereas in the case of lithium, sodium or potassium soaps, the preferred value is 0.7—0.95. About 10—25% of the soap is ordinarily required to give the necessary thickening effect.

A typical preparation of sulfurized lithium soap grease is as follows:

A mixture of 28.2 grams (0.1 equivalent) of highly refined oleic acid, 28.4 grams (0.1 equivalent) of stearic acid and 391 grams of a California solvent-refined paraffin base petroleum oil having a viscosity of 185 SSU at 210°F., was heated with stirring to 170°F., at which temperature the acids were neutralized by 100 ml. of 2N lithium hydroxide solution. This whole mixture was heated with stirring to 400°F., at which temperature 3.2 grams of sulfur was added. After the reaction mixture had been heated at a temperature ranging from 410 to 420°F. for two hours, the product was cooled in a large evaporating dish.

Gelling Liquid Hydrocarbons

Although U. S. Patent 2,668,098, issued to Standard Oil Company (Indiana) deals with hydrocarbon gels used for fracturing producing formations, it is interesting to note that the preferred gelling agent is potassium tridecyl xanthate.

Oxidized Hydrocarbon Soap Base Greases

According to U. S. Patent 2,669,543 issued to Cargill, Inc., lubricating greases can be made from oxidized hydrocarbons, as such, without the addition of any animal or vegetable fats or fatty acids. These lubricants are claimed to have great stability, low break-down when worked, and a very good oiliness. Soap bases made from such oxidized hydrocarbons are said to be compatible with paraffinic or naphthenic base mineral oils. Most of the greases can be kettle-finished, thus avoiding the multiple steps of providing homogeneous grease.

In carrying out the preparation of the base, a hydrocarbon or a hydrocarbon mixture, which at normal temperature and normal pressure is liquid or solid, or of high viscosity, is heated in a kettle with stirring facilities to a temperature preferably of 255°F., but not much higher than 300°F. In this heated mass is introduced a gas containing oxygen and carrying a minor percentage of moisture. To accelerate the oxidation, an oxidation catalyst is used, as well as a minor percentage of a metallic per-salt in an emulsion of water and an oleagineous material, and so forming an emulsion of the whole reaction mass during the time of the oxidation process. The method of oxidizing the hydrocarbons is fully described in Patent 2,391,236. When the oxidation has reached the desired saponification number the oxidized hydrocarbons are taken out from the kettle and washed and filtered. The washing of this product can be made with hot water, acidulated water, or salt water. After filtering, the product is ready to be used for soaps and lubricants.

General Procedure

Into a grease kettle is charged 200 parts of the 100 SUS at 100°F. refined naphthenic mineral oil. Then 100 parts of oxidized hydrocarbons are added, heat and stirring facilities are slowly put in action until both ingredients are dissolved. Then a calculated amount of saponifying agent in a saturated solution is poured into this mixture. Saponification starts immediately. The temperature is then slowly allowed to rise to about 220°F. to complete saponification. This temperature is maintained until most of the water has evaporated. When all of the water is gone, the temperature is raised to about 280°F. and then, to this basic grease mixture, 200 parts of pre-heated heavy

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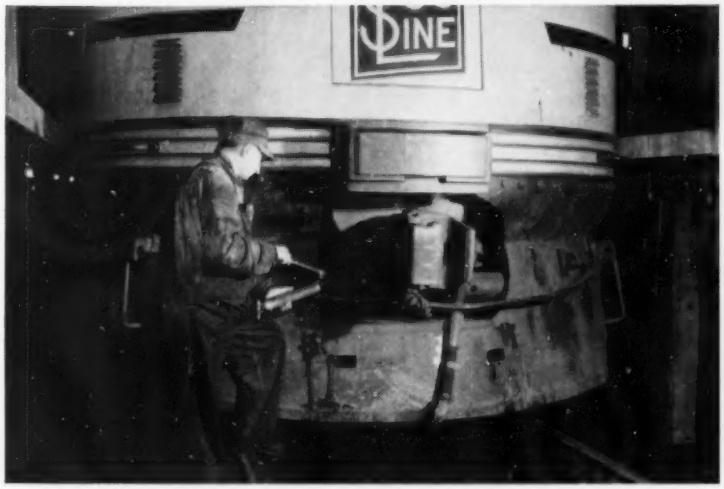

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naphthenic mineral oil of a viscosity of 240 SUS at 201°F. is added, step by step. The temperature of 280°F. is maintained until all the heavier mineral oil is entirely incorporated in the grease. The grease is then ready to be poured into containers. This can be done at 280°F. or, if desired, the grease can be stirred down to a lower temperature and then poured into containers ready for use.

In order that the lubricant may have a stable consistency after a considerable amount of working, it is necessary that the hydrocarbons, which are always heavier aliphatic hydrocarbons varying in consistency from liquid to solid at normal temperatures, be substantially oxidized, and that the unsaponifiable materials remain in the mixture. The hydrocarbon used as the starting material may and will be of varying natures, but when oxidized to produce saponification numbers in the range of about 155–190, the product will have been oxidized to such an extent that when formed into soap, produces lubricants of stable consistency that will withstand vigorous prolonged working without breakdown.

Examples of sodium, calcium, aluminum and lithium base greases are given.

Rust Preventive Grease

Lubricating greases containing both an oil soluble polyvalent metal sulfonate and a synthetic acid product obtained by the partial oxidation of petroleum wax, having "exceptional" rust inhibiting properties, are disclosed in The Texas Company's Patent 2,671,759. The combination of the two ingredients appears to have a synergistic effect.

Sulfonate products are claimed to have been proposed in the past for rust preventing uses, but these are said to have been insufficiently effective under severe conditions of high humidity, presence of salts, etc. The preferred sulfonates are the mahogany soaps obtained by treating a heavy oil with strong or fuming acid. The synthetic acid (second component) is obtained by partial oxidation of petroleum wax (such as scale wax) by usual methods, such as the one described in U. S. Patent 1,909,945.

The rust proofing of a lithium base grease prepared from a soap-forming material containing at least a major amount of hydroxy fatty acid (e.g. 12-hydroxy stearic acid), involves incorporation therein of 0.7–1.05% by weight of calcium mahogany sulfonate, 2—3% of a synthetic acid product having a neutralization number of 50–100 obtained by partial oxidation of petroleum wax, and about 2—3% of tallow. Such a grease is claimed to be capable of preventing substantially any rusting of steel panels in the salt spray rusting test for periods up to 100 hours.

Hoyst Ledpantz...never checks anything!

"ALL I SAID WAS..! I DON'T WANT ANY GAS, JUST GIMME A LUBE JOB'!"

Lubricate for Safety-Every 1,000 Miles

Technical Committee

Chairman T. G. Roehner, Director of the Technical Service Department, Socony-Vacuum Laboratories

The membership of the Symposium Committee for the October meeting in San Francisco is the following:

L. C. Brunstrum, Chairman, Standard Oil Co. (Indiana)
C. J. Boner, Battenfeld Grease & Oil Corp.
George Entwistle, Sinclair Refining Company
C. M. Finlayson, National Lead Company
Carl Watson, California Research Corporation
F. E. Woodward, Rock Island Arsenal

Ex-Officio Members

E. W. Adams, Chairman, Fellowship Subcommittee
H. L. Hemmingway, Program Committee
J. F. McGrogan, Technical Committee
T. G. Roehner, Technical Committee

The tentative program as of this date (June 8) is:

"STRUCTURE OF LUBRICATING GREASES"

Program	*Proposed Speaker*
Introduction	L. C. Brunstrum, Panel Chairman
Optical Methods*	B. W. Hotten
Indirect Methods**	J. A. Puddington
Fellowship Report	Mrs. V. Elersich
Thixotrophy of Greases	R. H. Leet
Panel Introduction	A. Bondi
Panel Discussion	25-30 members
Floor Discussion	

*Optical Methods—Electron Microscopy (both smear and ultra-thin sectioning); X-ray; Dark Field; etc.

**Indirect Methods—Rheology; Flow Birefringence; Solvent Studies; Electrical Methods; etc.

It will be noted that the session is made up essentially of two parts, namely, (1) presentation of lead papers and (2) discussion. Mr. L. C. Brunstrum has reported that the Committee is receiving splendid cooperation. Arrangements have been made for recording the discussions so they can be included as part of the written record of the Symposium.

At the recent meeting of the NLGI Board, it was decided that a Publicity Committee should be organized in order to obtain better publicity for the accomplishments of NLGI, including the work done by the Technical Committee. It is anticipated that by October "Recommended Practices for Lubricating Automotive Front Wheel Bearings" will be ready for a publicity release. The Subcommittee on this project, with Mr. Hugh L. Hemmingway as Chairman, has already taken steps to obtain the reaction of general factory service managers of passenger car manufacturers, truck manufacturers, and manufacturers of replacement and original equipment front wheel bearings. It is also expected that by October the Subcommittee on Delivery Characteristics of Dispensing Equipment for Lubricating Greases, with Mr. N. Marusov as Chairman, will have the "NLGI Tentative Method for Matching Lubricating Grease Flow Properties with Lubricating Grease Dispensing Pump Delivery Behavior at Low Temperatures" in shape for a publicity release.

The NLGI Technical Committee representatives on the Publicity Committee are:

Mr. J. F. Carter
The Aro Equipment Corporation
Bryan, Ohio

Mr. G. H. Link
Shell Oil Company
50 West 50th Street
New York 20, N.Y.

All members are urged to send them any ideas which they believe should be handled by the new Committee.

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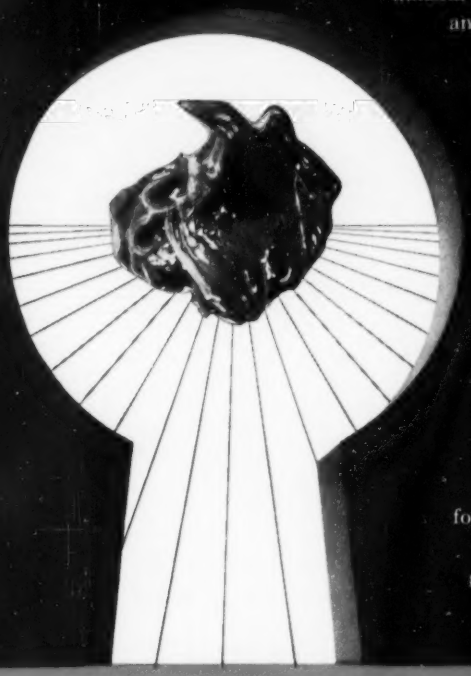

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PEOPLE in the Industry

Sparks Receives Chemists Award

The 1954 Gold Medal of the American Institute of Chemists has been awarded to Dr. William J. Sparks, co-inventor of Butyl synthetic rubber and an executive of Standard Oil Development Company.

Accepting the award, Dr. Sparks made a plea for international cooperation among friendly nations in the science of chemistry. He said that within the past 30 years, the United States has assumed world leadership in chemical thought and accomplishment. "Having attained that leadership," he added, "we must face the responsibilities that go with it."

As the 26th person to win the annual award, Dr. Sparks was cited "as an eminent chemist who has striven unceasingly for the promotion of the science of chemistry and the professional advancement of the chemist."

Dr. Sparks is director of Standard Oil Development Company's Chemical Division and is coordinator of exploratory research. With R. M. Thomas, also of that company, he invented and helped to perfect Butyl synthetic rubber.

Dr. Sparks is chairman of the National Research Council's Division of Chemistry and Chemical Technology, and holds active memberships in many other scientific organizations. In 1953 he was head of the U. S. delegations to the International Union of Pure and Applied Chemistry in Stockholm.

The award was presented by Dr. Gustav Egloff, of Chicago, chairman of the Institute's medal award committee. Dr. John C. Warner, president of Carnegie Institute of Technology, was the 1953 recipient.

Sixty-two per cent of today's energy comes from oil and natural gas. It is estimated that by 1960 man will perform only three per cent of the physical work in the United States. Machines will do 96 per cent and animals will do one per cent. Before 1859, when the oil industry started, man did 15 per cent, animals 79 per cent and machines 6 per cent.

Morehouse Appoints M. H. Baker

Morehouse Industries, manufacturers of Morehouse Mills, have announced the appointment of the M. H. Baker Company of Minneapolis to act as their representative in the State of Minnesota. Founded in 1951, the Baker Company has been active since that time in supplying soybean oil, fatty acids, and resins to the paint, plastics, rubber, and allied trades in Minnesota and Iowa.

Hoyst Ledpan'ts....never checks anything!
"HOYST, DID YOU KNOW THAT 74.7% OF THE MOTORISTS SAY CAR LUBRICATION IS THE MOST IMPORTANT PAID SERVICE?"

M. H. Baker, founder and president of the Baker Company, studied chemical engineering at Pratt Institute, and Virginia Polytechnic Institute as well as specialized courses at the University of Maryland and Northwestern University. He is now a registered chemical engineer in the State of Illinois and Minnesota. He is a member of the Chemical Market Research Association, the Commercial Chemical Development Association, Chemists Club, American Chemical Society, the American Institute of Chemical Engineers, Minnesota Industrial Chemists Forum, Paint, Varnish and Lacquer Association, Society of Plastics Engineers, and a past member of the Northwest Paint Production Club.

Kuehne Advances

The appointment of E. Richard (Dick) Kuehne, 37, of Lincolnwood, Ill., as Chicago district sales manager for Mallinckrodt Chemical Works, St. Louis, has been announced by G. C. Bradshaw, western division sales manager.

As Chicago district sales manager, Kuehne will be in charge of sales activities in Chicago and surrounding communities, Milwaukee and Madison, Wis., and the State of Iowa. This is part of the territory formerly supervised by regional sales manager, Walter R. Nay, who died April 6.

When the appointment was announced, Kuehne was confined to the Evanston Hospital, Evanston, Ill., where he was undergoing treatment for an eye ailment. Until Kuehne is able to actively take charge of the Chicago district, Warren F. Michener, manager of the laboratory chemical sales division in St. Louis, will supervise temporarily the Chicago office.

Kuehne joined Mallinckrodt in 1943 as a sales representative in the Chicago area. In 1951 he was appointed assistant district sales manager. Before coming to Mallinckrodt he was a Chicago salesman for the Pure Oil Company.

Kuehne is currently active in the Chicago Perfumery, Soap, and Extract Association. He was a member of the board of directors in 1952 and has worked with several committees, some as chairman, during nine years' membership in the association.

Highway transportation accounts for a business volume of 30 billion dollars annually.

More than 880,000 farm workers are dependent on automotive transportation.

The user cannot see it by looking in the container, but when he finds a lubricant doing an outstanding job, it's 2 to 1 a Metasap Aluminum Stearate Base is incorporated therein.

For Metasap Aluminum Stearates are today's *foremost* development in grease making. Lubricants made with them are moisture-proof, temperature-resistant, water-repellent . . . clear and uniform . . . able to perform superlatively under the tougest conditions.

Whatever your grease requirements, call upon Metasap – and profit by being able to meet every specification with the best possible grease for the job.

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Industry NEWS

Gulf Announces Tubeless Tire

A new high-safety tubeless tire, which protects against both punctures and blowouts was placed on the market recently by Gulf Oil Corporation.

Additional safety features are resistance to skid, long wear and cool running qualities which are superior to first line tires with safety tubes. Furthermore, cost is substantially less.

Inside the tire's body, extending completely around each bead, is a two-ply layer of rubber, cured to the cord ply and beads. This replaces the inner tube.

In addition, a gummy rubber puncture-sealing shield is incorporated beneath the tread area, extending to a little below each shoulder.

The new tire protects against bruise blowouts with its liner and puncture-sealing material, which prevent sudden deflation. A carcass bruise break which can often cause a blowout is either confined to a slow leak or, in severe cases, controlled safety until the driver can come to a normal stop.

Punctures are sealed in the tread crown area by the rubber sealant. This plastic gum surrounds a penetrating nail or other object, closing off air escape.

The shoulder area in most tires is the hottest running part. In the new tubeless, shoulders are deeply vented to throw off heat and promote safe, cool running.

Mounting, demounting servicing and repair is as easy as with regular tires. The tubeless tire can be recapped like any other.

Witco Opens Atlanta Sales Office

Witco Chemical Co. has announced the opening of a new sales office at Atlanta, Ga. The office is under the direct supervision of Clement Damen, who has been affiliated with the company since 1924.

The Atlanta office, while serving all industries, will specialize in manufacturers of rubber, paint, plastics, and grease.

Unusual Oil Terminal Serves Jobbers Only

When the Shell Oil Company undertook to design and build a terminal to handle petroleum products exclusively for petroleum jobbers, it was regarded as a revolutionary experiment. It proved so successful, and the business of the jobbers it serves has so flourished, that the terminal was virtually outgrown by the time it was completed.

"The Escanaba, Michigan, terminal," says J. G. Jordan, Shell vice president in charge of marketing, "is a striking example of the eagerness of business to assist associated small business to prosper."

DID YOU KNOW...
SCREEEEEEEECH
NOON WHISTLE
NAW, JUST TH' MACHINERY RUNNING DRY
EMPTY
FOR SALE SUITABLE FOR HOT DOG STAND
IF OIL WERE TO DISAPPEAR FROM THE UNITED STATES TOMORROW, 45,035,000 PASSENGER AUTOMOBILES WOULD STAND IDLE, AND ALL THE WHEELS OF INDUSTRY WOULD GRIND TO A HALT DUE TO LACK OF LUBRICATION

Shell's Escanaba terminal was opened in June 1953 to supply fifteen jobbers in the upper peninsula of Michigan and northwest Wisconsin, an area of about 16,000 square miles. It handles 16 million gallons annually of gasoline, range oil, and heating oil.

Before the terminal was built, some of the products ordered by jobbers in the area had to be freighted from Tulsa, Oklahoma, 800 miles away. Long overland hauls were also necessary during the five month closed navigation season on the Great Lakes. These factors made deliveries slow and uncertain.

But today, the Escanaba terminal, with a storage capacity of 164,390 barrels, can make quick deliveries year round. The long overland hauls by tank cars and trucks are largely eliminated. The terminal is supplied by lake tanker, normally from East Chicago, Indiana.

Built at a cost of about $300,000, the terminal is located on a 10½-acre site. The four tanks range in capacity from 67,140 barrels to 14,690 barrels.

Loading facilities include a single truck loading rack and two tank car loading spots. The Escanaba and Lake Superior Railroad has a spur into the plant site.

One out of every seven Americans is engaged in work in the transportation field.

Foote Announces Second Lithium Award Program

To stimulate and reward research in the uses of Lithium in ceramics, Foote Mineral Company is sponsoring the second Lithium award program. A total of $2,000 in cash prizes will be awarded to authors of the best papers describing heretofore unpublished development work. Any paper dealing with the use of a Lithium mineral or chemical in any form in a ceramic process or product will be eligible.

The competition, open to all professional engineers, researchers, technicians and students, is divided into two classes; professional and student. Separate awards will be made for three papers in each class. Closing date for entries is November 1, 1954, and all papers must be submitted by July 1, 1955.

It is the feeling of the sponsor that significant contributions can be made to the ceramic industry through continuing research with Lithium. The purpose of the Lithium award program is to foster such research by those engaged in the industry as well as by ceramic engineering students.

Complete rules for the Lithium award program are available upon request to the Lithium Award Chairman, Foote Mineral Company, 18 West Chelton Avenue, Philadelphia 44, Penna.

grease manufacturers

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Titre	39.0°—41.0° C.
Color Lovibond 1" Red	2—4
Color Lovibond 1" Yellow	15—30
Color Gardner	9 max.
Unsaponifiable	2.5% max.
Saponification Value	198—205
Acid Value	197—204
% F.F.A. as Oleic Acid	99.0% min.
Iodine Value (WIJS)	61.0 Max.

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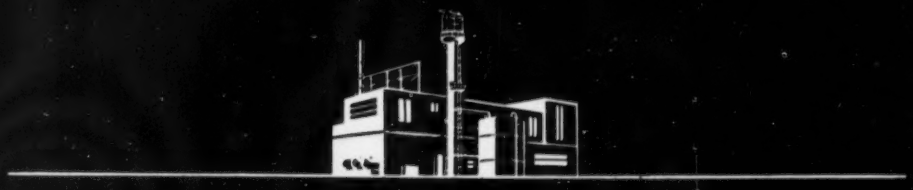

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HYDROFOL FATTY ACIDS 150 contains 90% Stearic Acid. High melting point makes this product suitable for grinding into fine powder. Acids "150" will not darken, oxidize or deteriorate during normal processing.

SPECIFICATIONS

Titre °C	62 to 64
Acid Number	195 to 201
Iodine Value	3.0 Max.
Saponification Value	196 to 202
Color (5¼ inch Lovibond)	15Y/1.5R

TYPICAL COMPOSITION
(Chain Length-Acids)

C_{16}	10.0%
C_{18}	90.0%
Unsaturated	3.2%
Saturated	96.8%

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Gulf Oil to Add to Cincinnati Refinery

The Gulf Refining Company has announced that contracts have been let for the construction of a platforming catalytic reforming unit and auxiliary units at its Cincinnati, Ohio, refinery. The contract was awarded to the Procon Company of Des Plaines, Illinois.

The new unit will have a capacity of 10,000 barrels per day and will use platinum as a catalyst. It will take low octane naphtha and up-grade it into high octane gasoline.

The platformer will also be capable of making benzine, toluene and zylene, all widely used in the chemical industry.

A boiler and cooling tower will also be constructed as auxiliary units for the platformer. New tankage and new pipe lines will be added to serve the new unit.

The manufacturing operations of the United States, with about 6 per cent of the world's population, depends at one point or many points on highway transportation.

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PETROSULS
(Petroleum Sulfonates)
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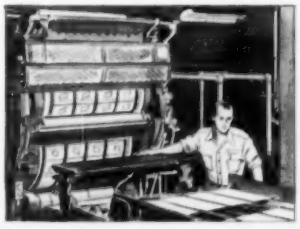
Let us measure you three ways for hand-tailored metal container service

When you come to Continental for steel containers, we treat you as if you were our only customer. We hand-tailor our containers, lithography and engineering to your particular needs. We do our level best to do things your way. If you'd like this kind of service, why not call in a Continental man today.

CONTAINERS. Continental makes steel containers for bulk products, in standard styles including pails, drums, handi cans. We're always ready to discuss special-purpose containers.



LITHOGRAPHY. Our artists are masters at adapting your designs to look well on containers of varying sizes and shapes. Our platemakers and pressmen work with the most modern equipment.

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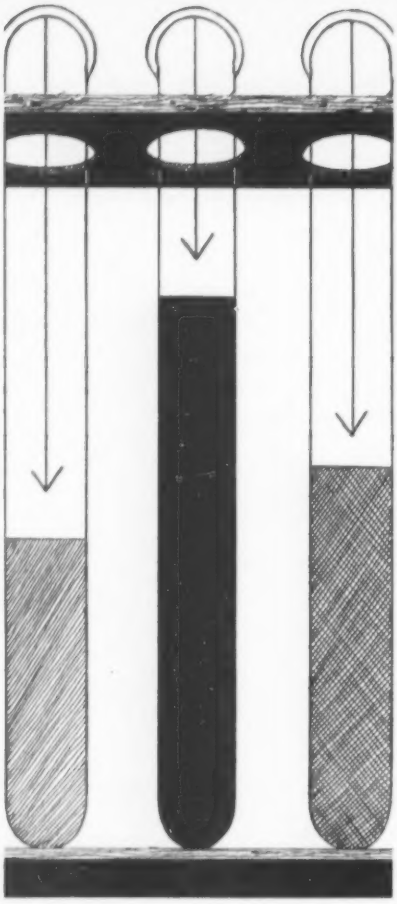

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Greases
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The Texas Company Announces New Test Rig

A novel test rig for studying the performance of hypoid gear lubricants has been designed and put into use by the main research center of The Texas Company.

The apparatus will accommodate any standard vehicle axle. A variety of road conditions can be simulated, and the gears under test can be loaded well beyond present day requirements.

Hypoid gears—a variety of spiral bevel gears with offset axes—are in universal use today in passenger cars. They are being used more and more in commercial vehicles as each year passes.

This type of gear poses critical lubrication problems because of the peculiarities of hyperboloidal ("hypoid") shaped teeth. The characteristic end-wise sliding and rolling action creates more severe lubrication problems from those encountered in more usual gears.

The design for the test apparatus was developed by the Engineering Research Department of Texaco's Beacon, N. Y., Laboratories, where the rig is installed. It is based on the familiar four-square loading principle which makes continuous use of the power being applied to the rig. Because it is a "closed circuit," the rig can take heavy loading on the gears under test without proportionate increase of power input to run the mechanism.

In effect the gear testing device brings the highway indoors. Engineers made careful studies of the change-of-gear cycle on actual road tests carried out near Bedford, Pennsylvania. It was determined, for example, how long a truck remained in each gear (at various speeds) in rolling country and on level highways.

From this information it is possible to establish through automatic control the same cycle of gear changes as required to drive a loaded truck over a predetermined terrain. Once the road condition, and the load, is decided upon, the gear-change cycle is established. The test rig will then repeat the cycle continuously through the duration of the test. Electrical control frees the operator for other tasks.

REPUBLIC STEEL PAILS AND DRUMS

for Oils, Greases, etc.

No. 9 pail with lug cover and choice of pour spouts for 5 gallons oil or 35 pounds grease.

REPUBLIC STEEL PAILS

Fabricated from black steel—outside painted or lithographed to order. Removable tops with lug covers, with or without pour spouts.

100 lb. or 120 lb. grease drum with 14 inch full open-top lug cover. Also made with 9 inch lug cover in center of head; offset bottom for stacking.

REPUBLIC STEEL DRUMS

55, 30 and 15 gallon capacities; and 100 lb. or 120 lb. grease drums. Full open head or bung type. Painted or fully decorated. Interior lacquered if desired.

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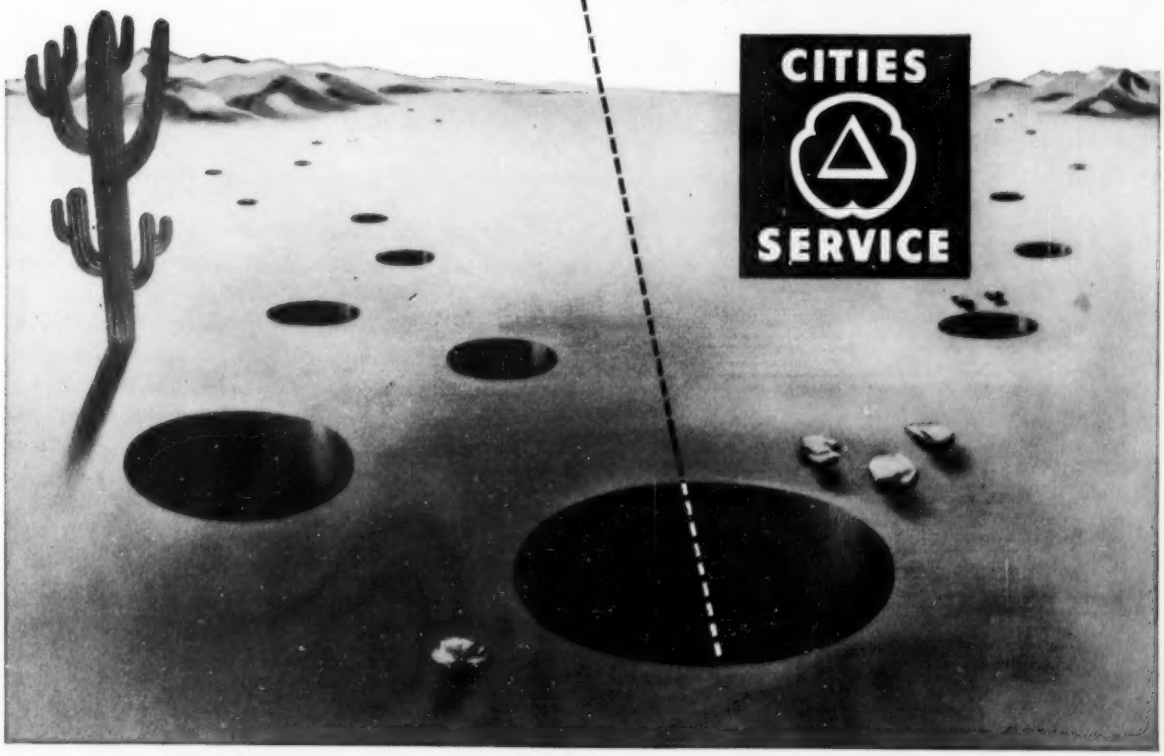
...and the well was DRY 67 times!

Out of 90 wildcat wells drilled by Cities Service in 1953, over 67 proved to be dry. And, you may say, "Bad business." But actually these dry wells represent the "good business" sense of the entire industry.

Even with all the latest scientific methods at their disposal, oil men cannot always be certain of a black-gold find beneath strange lands. What is important is that Cities Service, as well as the rest of the industry, is willing to risk huge sums on any reasonable evidence that they may find oil.

One company may decide not to drill an area, while another will say, "Let's take the risk." This is gilt-edge assurance to the nation that every possible area will be explored. It's a marvelous example of how our free enterprise, competitive system constantly influences all American business in a direction that will always benefit the consumer.

Cities Service will continue to make new oil finds to help fill the oil larders of the nation . . . known underground oil supplies are over four times what they were thirty years ago. Cities Service will continue to drill dry wells too . . . the odds are 8 to 1 against bringing in a producing discovery well. And these hundreds upon hundreds of dry wells, with the millions of dollars spent on them, will in themselves serve as a monument to the constant efforts of the American petroleum industry to keep our country strong and to keep our standard of living at the highest point the world has ever known.



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Manufacturers of

LUBRICATING GREASES

The load on the axle (and gears) is varied by adjusting a system of planetary gears which contact the drive shaft. The housing for the planetary gears is turned hydraulically, thus adding to the load the rig must overcome.

A run simulating the Bedford road test last 160 hours. A new carrier assembly (ring gear, pinion, differential) —the "third member assembly"—is used on each test run. This assembly is checked by the engineering department of the manufacturer before each test.

Socony Closing Olean Refinery

Because of past and prospective uneconomic operations for the plant, the Socony-Vacuum Oil Company, Inc., is taking preliminary steps to prepare for the eventual shutdown of its Olean refinery, one of the oldest in the United States, according to an announcement by George S. Dunham, director in charge of manufacturing for the company.

Efforts will be made to sell the properties to some industrial enterprise, Mr. Dunham said, so they can continue to provide jobs and contribute to the economic well-being of the community.

Enjay Announces Building Program

A building housing the newly-created Enjay Laboratories Division and containing 11 laboratories and 14 offices will be constructed on the Standard Oil Development Company's Research Center grounds at Linden, New Jersey this year, it has been announced.

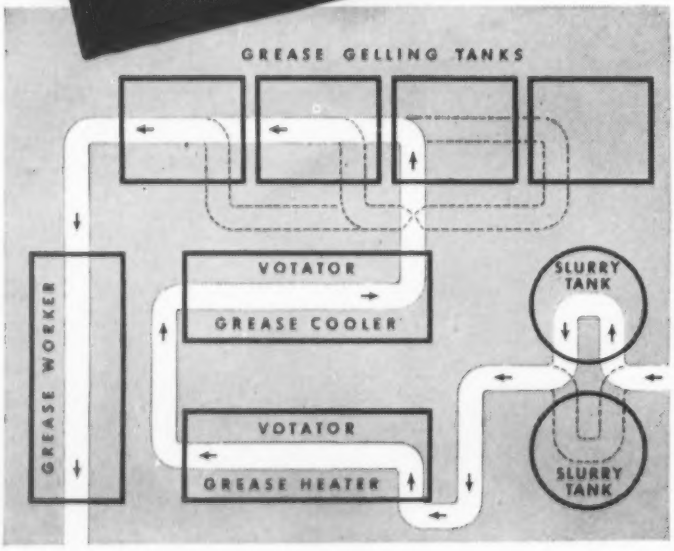
Construction, already under way, is scheduled to be completed by November 1, 1954, on the 54-foot wide, 230-foot long brick and cement structure.

Dr. Miller W. Swaney, formerly assistant director of the Development Company's Chemical Division, was recently appointed director of the division.

Lubricate for Safety

Votator®
GREASE MAKING APPARATUS

...makes a top quality product at **lower cost!**



VOTATOR* Grease Making Apparatus converts an aluminum or lithium base slurry into smooth, glossy-sheen grease of highest quality . . . on a continuous basis. The result is high volume production coupled with many operating economies such as: pan-cooling is eliminated; less space is required than for batch methods; reworking is eliminated because of close quality control; operator attention is minimized because of closed-system, automatic control.

Write for complete information. The Girdler Co., Votator Division, Louisville 1, Ky.

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The GIRDLER Company
A DIVISION OF NATIONAL CYLINDER GAS COMPANY
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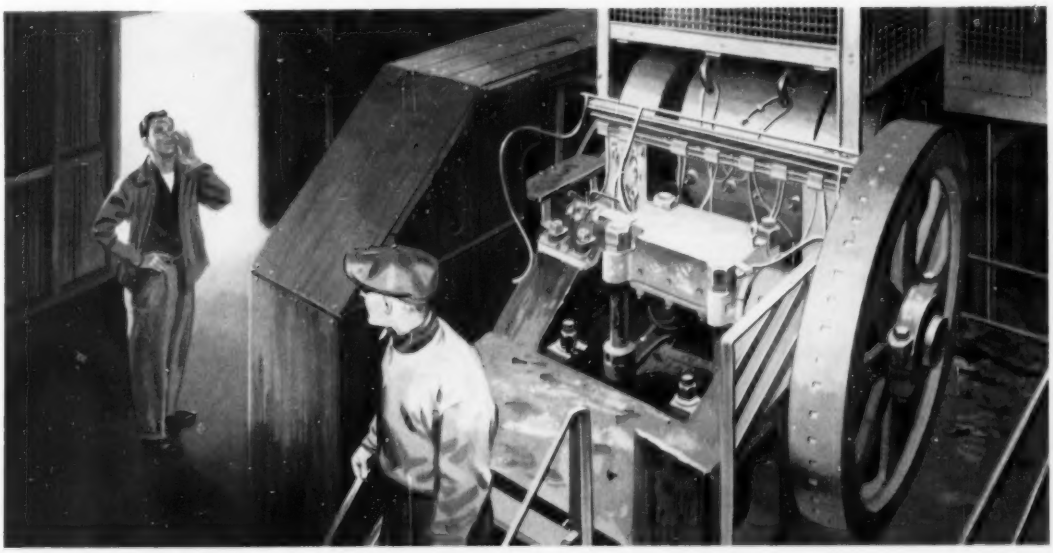
Bentone*34 greases *better*

for longer trouble-free service life!



HERE'S WHAT BENTONE* 34 GREASE USERS SAY . . .

"During 12-month test on 4′ x 5′ jaw crusher, using a Bentone grease, reduced grease consumption by 4,837 pounds; an annual savings of $2,728 in grease cost over grade of grease formerly used."

"Grease clean-up time has been reduced 156 man hours per year, and 78 hours of operating time per year formerly lost for hot toggles have been eliminated."

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BAROID SALES DIVISION ★ P. O. BOX 1675 ★ HOUSTON 1, TEXAS

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The best-planned production line can bog down, if containers are late at the packaging point. Has this happened to you? Could it happen in your plant?

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Open-head and Closed-head Pails
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PEOTONE, ILLINOIS
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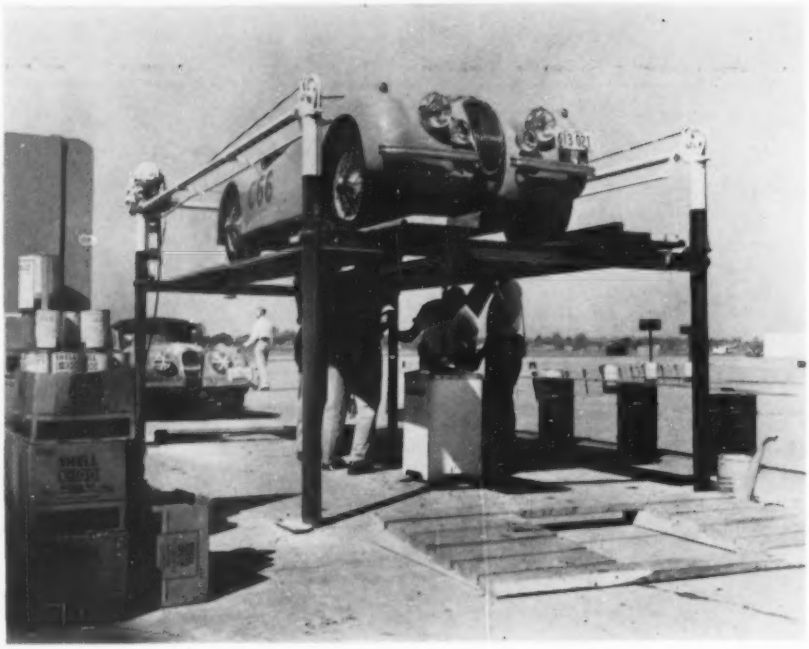

The portable lift on which this sleek sports car is being serviced is part of the equipment in the service centers provided by the Shell Oil Company at the sports car races in which it participates. Shell, which has been active in the sport for several years, has announced it plans to take part again this year in about a dozen events to be held under the auspices of the Sports Car Club of America.

Witco Expands In England

Witco Chemical Co., Ltd., of Bush House, London, has entered the manufacturing field through the acquisition of a factory and technical research laboratory at Droitwich, Worcestershire, England.

The factory comprises a modern industrial plant in Union Lane. At the outset, the plant is manufacturing synthetic latex compounds for use in the production of latex-base paints. Ultimately the new plant will produce the same chemicals as now manufactured in the United States by Witco Chemical Co.

Witco opened a London office in 1935 as Witco Chemical Co., Ltd. Overseas sales from the new plant will continue to be handled by the Witco export department in the London office.

The Droitwich operation is under direct control of Witco Chemical Co., Ltd., and manufacturing activities are in charge of D. Roberts, L. I. R. I., and J. McHugh, B. Sc., A. I. R. I., both with years of experience.

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NEW ORLEANS, LOUISIANA
Manufacturers of Quality Lubricants
AVIATION • INDUSTRIAL • AUTOMOTIVE • MARINE

1929 • 1954

With Research Comes Quality • With Quality Comes Leadership

Naples Refinery Wins Socony Contest

The Naples refinery of Socony-Vacuum Italiana, S.P.A. has been declared the 1953 winner of the annual safety contest among nine Socony-Vacuum refineries in five European countries. The achievement marks the climax of two years of progress in accident prevention during which the refinery advanced from last place in 1951 to third place in 1952 and to first place in 1953.

A bronze trophy was presented to the refinery's 1,255 employees at ceremonies held in May. Representatives of the company and officials of the Italian government participated.

The contest is held annually by Socony-Vacuum to promote programs of accident prevention throughout the manufacturing installations of its affiliated companies in Europe. Through these safety programs, employees study their work so they can learn to do each job efficiently and safely. Their experience is passed on to fellow employees at safety meetings. Consequently, each employee learns more about his neighbors' jobs and gains a better idea of general plant operation.

New Study Group

Appointment of a study group to consider the establishment of an Operations and Engineering Committee in the Division of Marketing of the American Petroleum Institute has been announced.

M. M. Becks, of Socony-Vacuum Oil Co., New York, was named Chairman of the Committee by R. M. Bartlett, of Gulf Oil Corp., Pittsburgh, Pa., the API Vice President for Marketing.

Other members are Harold Cooper, of Union Oil Company of California, Los Angeles; R. G. Emmett, of the Pure Oil Co., Chicago; John Hall, of Shell Oil Co., New York; W. K. McCloy, of Gulf Oil Corp., Pittsburgh, Pa., and Robert Niles, of Standard Oil Company (Indiana), Chicago.

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The open-top, lug-cover grease pail shown here is just one of many G. P. & F. steel containers ready to go to work for you. Sturdy, air-tight and leak-proof, these grease pails are available in 25-lb. size (3½ gal.) and 35-lb. size (5 gal.).

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WITCO STEARATES

Witco grease-grade stearates produce medium to extremely high gels of excellent stability, smoothness and color, and their superior gelling characteristics tend to make them more economical.

They are especially noted—and noteworthy—for a high degree of uniformity, freedom from foreign matter, low moisture and low soluble salt content.

Witco manufactures a complete line of stearates under closely controlled conditions, to meet your specific application requirements:

WITCO Aluminum Stearate No. 22-G . . . extremely high gel. Produces greases of excellent stability with minimum tendency to bleed. Excellent color and clarity.

WITCO Aluminum Stearate No. 22-C . . . very high gel. Outstanding performance in Pennsylvania base and high viscosity index stocks.

WITCO Aluminum Stearate No. 23 . . . medium-high gel. Excellent economy. All around good performance in a variety of oil stocks.

WITCO Aluminum Stearate No. 22-H . . . medium-high gel. Excellent economy and performance. Produces smooth, stable greases. Particularly recommended for Gulf Coastal and low viscosity index stocks.

WITCO Aluminum Stearate No. 22 . . . medium gel strength. Suitable wherever a definite percentage of soap is required.

WITCO Lithium Stearate . . . forms clear, light-colored greases with excellent water resistance. Operating temperatures from −90°F to 400°F. 6% to 8% soap ample for multipurpose greases.

WITCO Lithium Hydroxystearate . . . good water resistance and high stability over a wide temperature range. Excellent non-corrosive properties. Well-suited for synthetic greases.

Also Barium, Calcium, Lead, Magnesium, Sodium, Stearates; Aluminum Octoate. "Custom-made" stearates available. Our Research Laboratories have worked with a large number of oils from various sources and can recommend a stearate meeting your special requirements.

Write for technical information and/or samples.

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Cleveland • San Francisco • Akron • London
and Manchester, England

FUTURE MEETINGS of the Industry

JUNE, 1954

13-18 American Society for Testing Materials (annual meeting and exhibits), Sherman Hotel, Chicago, Ill.

17-19 American Petroleum Institute (Division of Production, Eastern District), Greenbrier Hotel, White Sulphur Springs, W. Va.

21-25 American Inst. of Electrical Engineers (combined summer and Pacific general meeting), San Francisco, Calif.

24-25 Western Petroleum Refiners Assn. (regional meeting), Leonard Refineries Auditorium, Alma, Mich.

27-July 1 Petroleum Equipment Suppliers Assn., Manoir Richelieu, Quebec, Canada.

AUGUST, 1954

16-18 Society of Automotive Engineers (national West Coast meeting), Los Angeles, Calif.

SEPTEMBER, 1954

8-10 Oil Industry Information Committee, Conrad Hilton Hotel, Chicago, Ill.

12-14 Empire State Petroleum Assn., Hotel Syracuse, Syracuse, N.Y.

12-16 Society of Automotive Engineers (national tractor meeting), Schroeder Hotel, Milwaukee, Wis.

12-16 American Inst. of Chemical Engineers, Colorado Hotel, Glenwood Springs, Colo.

12-17 American Chemical Society, New York, N. Y.

13-14 Packaging Institute (petroleum packaging committee), Philadelphia, Pa.

15-17 National Petroleum Assn. (52nd annual meeting), Traymore Hotel, Atlantic City, N. J.

16-17 Mid-Continent Oil and Gas Assn. (annual meeting), Roosevelt Hotel, New Orleans, La.

22-23 Ohio Petroleum Marketers Association (fall conference and golf tournament), Hollenden Hotel and Westwood Country Club, Cleveland, Ohio.

23-24 Western Petroleum Refiners Assn. (regional meeting), Henning Hotel, Casper, Wyo.

26-28 Pennsylvania Petroleum Assn., Inc., Pocono Manor Inn, Pocono Manor, Penna.

27-28 Independent Oil Compounders Association (7th annual meeting), Sheraton Hotel, Chicago, Illinois.

OCTOBER, 1954

4-6 Texas Mid-Continent Oil and Gas Assn. (annual meeting), San Antonio, Texas.

4-9 Society of Automotive Engineers (national aeronautic meeting), aircraft engineering display, and aircraft production forum, Hotel Statler, Los Angeles, Calif.

10-12 National Assn. of Oil Equipment Jobbers (4th annual meeting), Congress Hotel, Chicago, Ill.

Week of Oct. 18 Society of Automotive Engineers (national transportation meeting), Boston, Mass.

20-21 Nebraska Petroleum Marketers Assn. (annual convention), Paxton Hotel, Omaha, Neb.

21-22 Western Petroleum Refiners Assn. (Garrett Hotel), El Dorado, Ark.

23-25 National Association of Oil Equipment Jobbers (annual meeting), Hotel President, Kansas City, Mo.

25-26 Independent Petroleum Assn. of America (annual meeting), Tulsa, Okla.

25-26 Independent Petroleum Assn. of America (annual meeting), Shamrock Hotel, Houston, Texas.

25-27 NLGI ANNUAL MEETING, MARK HOPKINS HOTEL, SAN FRANCISCO, CALIF.

25-29 American Institute of Electrical Engineers (fall general meeting), Chicago, Ill.

26-27 Society of Automotive Engineers, national diesel engine meeting, Hotel Statler, Cleveland, Ohio.

NOVEMBER, 1954

4-5 Society of Automotive Engineers (national fuels and lubricants meeting), Mayo Hotel, Tulsa, Okla.

8-11 American Petroleum Institute (34th annual meeting), Conrad Hilton Hotel and Palmer House, Chicago, Ill.

28 to Dec. 3 American Socy. of Mechanical Engineers, Statler Hotel, New York, N. Y.

29-30 Packaging Institute (Petroleum Packaging Committee), New York, N. Y.

DECEMBER, 1954

2-7 National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia, Penna.

8-10 Oil Industry Information Committee, Waldorf-Astoria, New York, N. Y.

12-15 American Inst. of Chemical Engineers (annual meeting), Statler Hotel, New York, N. Y.

JANUARY, 1955

10-14 Society of Automotive Engineers (golden anniversary annual meeting), The Sheraton-Cadillac Hotel and Hotel Statler, Detroit, Michigan

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Q **Is industry getting Foote lithium compounds today?**

A The simple answer is "Yes"—to the tune of several times the quantity supplied industry in 1951. (And 1951 was a record year to that time.) We realize that this is not nearly enough to meet the greatly increased industrial demand that has steadily grown since 1950.

Q **Can I plan on using large quantities of Foote lithium in the forseeable future?**

A Again the answer definitely is "Yes." Foote production is being increased to the point that early in 1955 Foote will be delivering lithium compounds to meet scheduled industrial demands.

Q **What about the rumors that all lithium is going to be set aside for a specific purpose?**

A Obviously, Foote Mineral Company would not have answered "Yes" to the first two questions above if the rumors were true.

Kings Mountain, N.C. . . . where Foote is mining the largest known deposits of spodumene.

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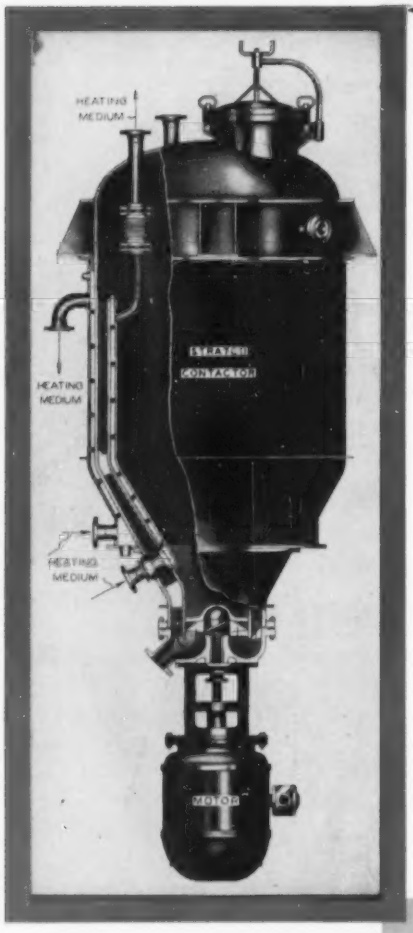

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